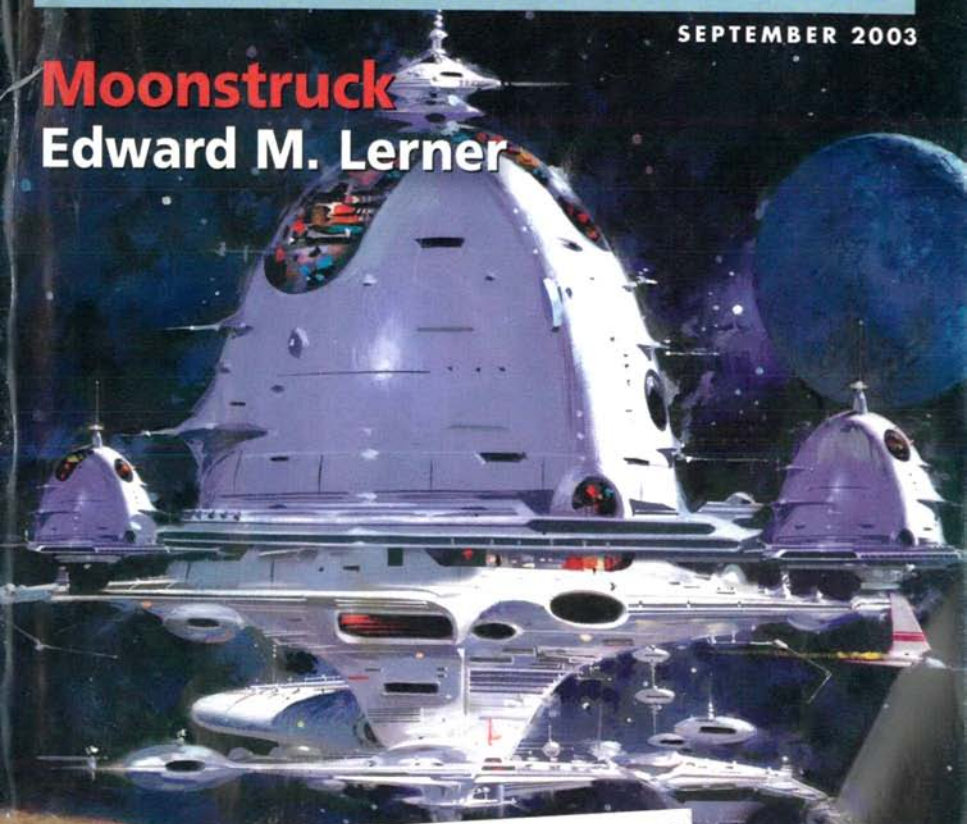
ANALOG

SCIENCE FICTION AND FACT

SEPTEMBER 2003

Moonstruck
Edward M. Lerner



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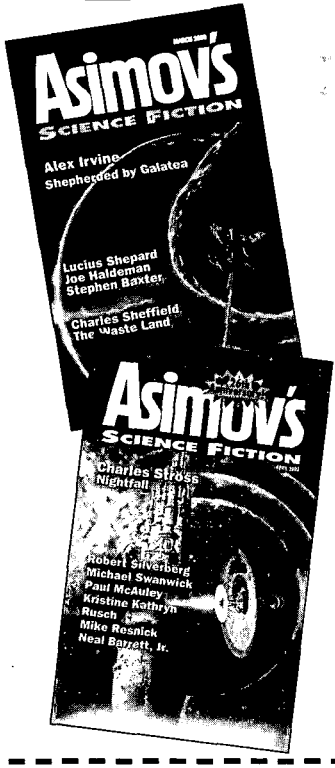

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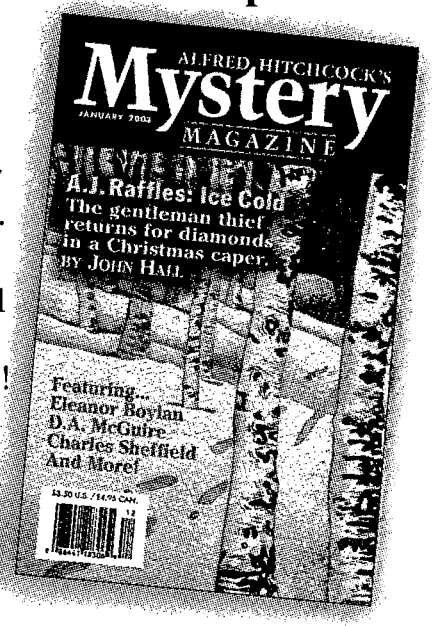

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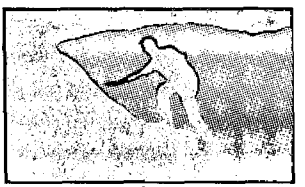

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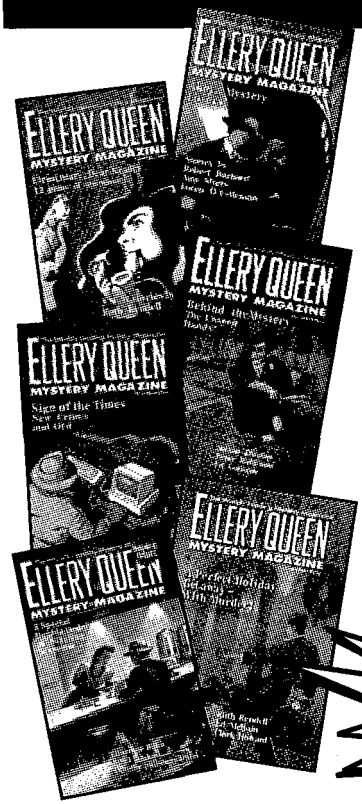

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EDITORIAL Stanley Schmidt

FITTING MEMORIALS

Less than a week ago as I write this, the space shuttle *Columbia* broke up during atmospheric reentry. Less than three days before that, I had bought Edward M. Lerner's serial *Moonstruck*, which begins in this issue. Almost as soon as you start reading it, you'll see why Ed and I were struck by the painful eeriness of the timing.

Naturally both of us, and I would assume just about anybody reading this magazine, were appalled and saddened by the loss, and deeply sympathetic to the families of the crew. But how, if at all, should the real tragedy affect our publication of *Moonstruck*?

Almost immediately after the disaster, changes were being announced elsewhere. Movies, trailers for movies, television shows, and commercials were pulled or changed because they contained incidents similar to what had just happened and the producers or their sponsors didn't want to appear insensitive. Should we contemplate any such change?

We contemplated, but it didn't take long to decide that *Moonstruck* should proceed right on schedule, with no change beyond the small and obvious ones of acknowledging that the characters in the story remember *this* unwelcome bit of history, too. For one thing, several months would pass before the story saw print, so the similar events and the emotions they produced would be less fresh. For another—and more important—we're convinced that the astronauts themselves would have insisted that "the show must go on," referring both to the real space program and to fictional explorations of the issues surrounding it.

The *Challenger* and *Columbia* crews were doing something exceedingly important, and they were well aware that it involved substantial risks. I suspect they would do everything in their power to haunt us mercilessly if we were so stupid as to drop it all because of an accident, or even several accidents over the brief history of space exploration. Yet, quite predictably, within days—within *hours*—we began hearing voices calling for the abandonment of the shuttle program, or manned spaceflight, or *any* spaceflight. "I don't know why we're going up there," one citizen was quoted as saying. "I think we have enough problems down here."

Sigh. If a "man on the street" doesn't get it to that extent, after all these years, he may never get it. Of course we have problems down here; if we wait for all those to be neatly wrapped up before we look any higher, it will never happen. And in fact, our problems down here are large parts of the reason why we need to be looking outward. Even the gentleman in that interview uses technology every day that would never have been developed if not for the space program, but I don't expect anybody to consider the exploration of space to be justified by spin-offs alone. Our needs out there are more fundamental. Some are practical, like the chance to use extraterrestrial resources to raise the stan-

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dard of living while reducing pollution and the depletion of resources here on Earth. Some are even more important in the long run, if harder to explain in terms of immediate gratification, like the powerful desire shared by many (not all) humans to keep pushing the boundaries of knowledge and understanding.

And the big one I'm going to talk about a little later.

Astronauts—and their families—have always understood these things; if they didn't, they wouldn't be astronauts. Nobody forced them to, and in fact they went through rigorous training and hardships to earn the privilege. But they understood the payoffs—even the big, intangible ones. "The important achievement of Apollo," said Neil Armstrong, "was a demonstration that humanity is not forever chained to this planet, and our visions go rather farther than that."

They also understood that we'll never get the payoffs if we stop trying when we have a bad day—even a *really* bad day. "If we die," Apollo astronaut Gus Grissom said shortly before he did, "we want people to accept it. We're in a risky business, and we hope if anything happens to us it will not delay the program. The conquest of space is worth the risk of life."

He was right, and the public needs to understand that he meant every word of it—because the risk of life was, is, and will remain very real. Any truly pioneering venture is dangerous, and pioneering on such a grand scale as this is dangerous on a grand scale, even if several trouble-free years sometimes seduce us into complacency. *Columbia* was not the first fatal accident in the exploration of space, and it will not be the last; but none will be a reason to give up. On the contrary, the most fitting memorials that can be erected to fallen astronauts are to continue the work they started—and, for those of us not in a position to participate directly, to keep pushing for that continuation and reminding those who've forgotten or never understood why it's important.

I don't intend to do a lengthy discourse on the reasons for that here. Most *Analog* readers are quite familiar with them, though they may disagree vigorously on the details. You may just need a reminder to do some of your preaching to people other than the choir—NASA, for example, your representatives in government, and especially the children. Many of them may have been especially traumatized by this event, and yet they, more than the rest, will bear the burdens—and reap the rewards—of making the future worthwhile.

Certainly we should reflect on what went wrong, and how we can keep it from happening again. A number of possibilities have suggested themselves. There may be design problems in the shuttle that need to be corrected, either to make it more resistant to trouble or to

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enhance the crew's chances for survival when trouble happens. In particular, many people have said the crew should have had a means to eject. That would certainly be desirable; in the past it has been considered impractical, but maybe somebody looking at the problem with fresh eyes could see a way to do it. Maybe it's time for the shuttle itself to be replaced with something fundamentally new and improved—though if that's done, nobody should be surprised when a new design comes up with new and surprising ways to fail.

Either way, one thing that's clear is that NASA needs adequate funding to do whatever it does. Engineers there have been complaining for years that their budgets were pared so close to the bone that they were forced to cut corners, and sooner or later the price would be paid in the coins of safety and reliability. We have been warned; maybe it's time for those who control purse strings to listen.

One option that always tempts some at times like this is the proposal to ditch *manned* spaceflight. "Any specific mission you can identify to do in space, you can design and build an unmanned spacecraft to do it more effectively, more economically, and more safely," NASA historian Alex Roland was quoted as saying in *The Wall Street Journal*. He may well be right, when it comes to relatively simple physics or biology experiments; but in my opinion he goes too far, and misses a vital point, when he adds, about manned spaceflight, "It's circus, it's just pure circus." It's far more than that, because there's one kind of science for which his statement is clearly wrong: the science of how the human body and mind respond to the unique challenges of spaceflight, such as prolonged weightlessness and isolation.

And it's not just about science—it's about survival. Mr. Roland might well respond to my objection by saying that it's not necessary to know more about how humans respond to space if we stop sending them there, and if all other science can be done at least as well by robots, we *can* stop sending them there. True, I might counter, but since when is science to be done only because it's necessary? But I wouldn't dwell on that, because the more important point, I repeat, is that it's not just about science. There may be times when we *have* to send people into space, or resign ourselves to the extinction of our species.

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That is the "big one" I mentioned earlier.

Now, the Universe at large probably does not care whether humans go extinct or not, and it may be hard to make a purely rational case for why it matters. But it matters very much to most of us who are human. Even though our species has done some massively reprehensible things, it has also achieved things that many of us would very much like to see survive as long as possible. If you are among those who care about that, you must face the fact that we are all on a spaceship, and it, too, is subject to catastrophic failure. It's a much bigger spaceship than *Challenger* or *Columbia*, and its catastrophic failures happen on a much longer time scale; but they do happen. We have clear fossil records of several massive extinction events, and we're pretty sure that at least some of them were triggered by astronomical causes that we know will happen again. We don't know when, but it could be sooner rather than later. Science fiction writers have suggested any number of other kinds of worldwide catastrophes that could happen, and it's becoming increasingly clear that some of those could result from human intervention—either collective behavior, or massively destructive acts by small groups of individuals.

If and when any of those *does* happen, the only insurance policy against complete human extinction is to make sure some of us, and our creations, are somewhere else. And the only way I know to insure that is to continue the work our astronauts have begun: the work of learning how humans can travel and live beyond this fragile basket in which we currently keep all our eggs. □

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MOONSTRUCK

Part One of Four

Edward M. Lerner

Illustration by Vincent Di Fate

***Should* one look a gift horse in the mouth?**

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PROLOGUE

"T minus five minutes, and holding."

It wasn't even ten in the morning, but the day was already hot. Kyle Gustafson squirted another dollop of sunscreen into his palm, then rubbed his hands together. Smearing it over his face and neck, he grimaced: he reeked of coconut oil. He made a mental note to avoid all open flames until he showered.

Kyle had a Scottish-American mother and a Swedish-American father, a combination that Dad called industrial-strength WASP. He didn't belong below the forty-fifth parallel, let alone outside beneath Cape Canaveral's summer, sub-tropical sun—but he never missed an opportunity to witness a launch. His job helped: who better than the presidential science advisor to escort visiting foreign dignitaries to Kennedy Space Center?

"You could wear a hat, my friend."

I look really stupid in hats, Kyle thought. Turning towards his Russian counterpart, he suppressed that answer as impolitic. Instead, he changed the subject. "Sorry for the delay, Sergei. The hold is built into the schedule to allow time for responding to minor glitches."

"T minus five minutes, and holding."

His guest said nothing. Sergei Denisovich Arbatov was tall, wiry, and tanned. He'd been born and raised in the Crimea, the Black Sea peninsula once popularly called the Russian Riviera. That nickname had gone out of vogue when the USSR self-destructed, and an independent Ukraine had made it clear that ethnic Russians were no longer welcome. In 1992, Sergei had moved his family to Moscow, where he'd moved up rapidly in the new, democratic government. It wasn't clear to Kyle how Sergei avoided the Muscovite's traditional pallor—unless it was by finagling trips to Florida.

"T minus five minutes, and counting."

The single-word change in the announcement made Kyle's pulse race. Across the plain from their vantage point at the VIP launch viewing area, *Atlantis* shimmered through the rising waves of heated air.

The shuttle on Launch Pad 39B stood 184 feet tall, the dart-like body of the orbiter dwarfed by the solid rocket boosters and external fuel tank to which it was attached. All but the tank were white; the expendable metal tank, once also painted white, was now left its natural rust color to reduce takeoff weight by 750 pounds.

"T minus four minutes, thirty seconds, and counting."

Kyle continued his standard briefing. "The gross weight of the shuttle at launch is about 4.5 million pounds, Sergei. Impressive, don't you think?"

"Apollo/Saturn V weighed a half again more." The gray-haired Russian smiled sadly. "We never made it to the moon, and you Americans have forgotten how. I don't know who disappoints me more."

Kyle had been thirteen the night of the first moon landing. Afterward, he'd lain awake all night, scheming how he, too, would sometime, somehow, make a giant leap for mankind. The idealist in him still shared Arbatov's regrets. Many days, only that boy's dream sustained Kyle through Washington's game-playing and inanity. Someday, he told himself, he *would* make it happen.

Someday seemed never to get closer.

"T minus four minutes, and counting."

Nervously, Kyle ran his fingers through hair, once flame-red. Age had banked the fire with ashes, for a net effect beginning to approach salmon. Too late, he remembered the sunscreen that coated his hands. "We'll go back, Sergei," he answered softly, speaking really to himself. "Men will walk again on the moon. We'll visit other worlds, too." He shook off the sudden gloom. "First, though, we've got a satellite to launch."

"T minus three minutes, ten seconds, and counting." Loudspeakers all around them blared the announcement.

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The Earth's atmosphere is effectively opaque to gamma radiation. In 1991, to begin a whole new era in astronomy, *Atlantis* had delivered the Gamma Ray Observatory to low Earth orbit. After years of spectacular success, the GRO had had one too many gyroscopes fail. NASA had deorbited it in 2000, in a spectacular but controlled Pacific Ocean crash.

Now another *Atlantis* crew was ready to deploy GRO's replacement. Major Les Griffiths, the mission commander, had proposed that the mission badges on the crew's flight suits read, "Your full-spectrum delivery service." The suggestion was rejected as too flippant. A mere three missions into the post-*Columbia* resumption of shuttle flights, American nerves remained raw.

"Da." Arbatov turned to the distant shuttle. He sounded skeptical. "Then let us watch."

The remaining minutes passed with glacial slowness. Finally, a brilliant spark flashed beneath *Atlantis*. Golden flames lashed at 300,000 gallons of water in the giant heat/sound-suppression trench beside the launch pad, hiding the shuttle in a sudden cloud of steam. Kyle's heart, as always, skipped a beat, anxious for the top of the shuttle to emerge from the fog. A wall of sound more felt than heard washed over them. Faster than he could ever believe possible, no matter how often he saw it, the shuttle shot skyward on a column of fire and smoke. Chase planes in pursuit, it angled eastward and headed out over the ocean. The sound receded to a rumble as he shaded his eyes to watch.

"Kyle!"

The American reluctantly returned his attention to his guest. Arbatov still stared at the disappearing spacecraft, one of the mission-frequency portable radios that Kyle's position had allowed him to commandeer pressed tightly to his ear. Kyle's own radio, turned off, hung from his wrist.

"Nyet, nyet, nyet!" shouted the Russian.

The presidential advisor snapped on his own radio. "Roger that," said the pilot. "Abort order acknowledged." The hyper-calm, hyper-crisp words made Kyle's blood run cold.

A speck atop a distant flame, the shuttle continued its climb. The far-off flame suddenly dimmed; the three main engines had been extinguished. *What the hell was happening?* "Shutdown sequence complete. Pressure in the ET"—external tank—"still rising. Jettisoning tank and SRBs." Unseen explosive bolts severed the manned orbiter from the external tank; freed from the massive orbiter, the tank and its still-attached, non-extinguishable, solid-fuel rocket boosters quickly shot clear. The manned orbiter coasted after them, for the moment, on momentum.

Clutching their radios, Kyle and his guest leaned together for reassurance. "Pressure still increasing."

Light glinted mockingly off the sun-tracking Astronaut Memorial, the granite monolith engraved with the names of astronauts killed in the line of duty. It seemed all too likely that the list was about to grow by five more names.

"Pressure nearing critical." He recognized the voice from Mission Control. "Report status."

What pressure? In the ET? Was it about to blow? Two Sea-Air Rescue choppers thundered overhead as he did a quick calculation. *The ET must still contain at least 250,000 gallons of liquid hydrogen!*

"Beginning OMS burn."

The distant speck re-grew a flame—had the orbital-maneuvering-system engines ever been fired before inside the atmosphere?—and began banking towards the coast. Unaided by SRBs, its main engines unusable without the ET, the orbiter seemed to lumber, seemed mortally wounded. "Suggest my escorts make tracks."

"Pressure at critical. Crit plus ten. Crit plus twenty. Twenty-three. Twenty-four."

An enormous fireball blossomed

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above the escaping orbiter. From miles away, Kyle saw the craft stagger as the shock wave struck. "Tell Beth that I love her." The distant flame pinwheeled as *Atlantis* began to tumble. Moments later, the roar and the shock wave of the blast reached the Cape, whipping Kyle and Sergei with a sudden gale of sand and grit. The distant spark extinguished as safety circuits shut down the tumbling craft's rocket engines.

The orbiter began its long plunge to the sea, with both chase planes diving futilely after it.

Like its mythical namesake, the orbiter *Atlantis* slipped beneath the silent and uncaring waves to meet its fate.

CHAPTER 1

Without warning, the Toyota pickup swerved in front of Kyle. He tapped his brakes lightly—this near the I-66 exit to the Beltway, such maneuvers were hardly unexpected—and gave a *pro forma* honk. The yahoo in the pickup responded with the traditional one-fingered salute. The truck's rear bumper bore the message: Have comments about my driving? Email: biteme@whogivesashit.org.

Such is the state of discourse in the nation's capital.

Sighing, Kyle turned up his radio for the semi-hourly news summary. There was no preview of this morning's hearing. That was fine with him: he'd never learned to speak in sound bites. If the session made tomorrow's *Washington Post*, his testimony might rate a full paragraph of synopsis.

The good news was: today's topic wasn't the *Atlantis*.

Reliving the disaster in his dreams was hard enough; the science advisor's presence had also become *de rigueur* for every anti-NASA representative or senator who wanted to use the disaster to justify ending the manned space program. *Challenger*, *Columbia*, and now *Atlantis* . . . after three shuttle catastrophes, they spoke for much of the country. By comparison, today's session about technology for improved enforcement of the Clean Air Act would be positively benign.

As traffic crept forward, he tried to use the time to further prepare for the senatorial grilling. He knew the types of questions his boss would have posed to ready him: What would he volunteer in his opening statement? What information needed to be metered out in digestible chunks? Whose home district had a contractor who'd want to bid on the program? Who was likely to leave the session early for other hearings? All the wrong questions, of course, when Kyle wanted to talk about remote sensing technology and computing loads. There was too little science in the job of presidential science advisor.

In any event, he had to swing by his basement cranny in the OEOB for last-minute instructions. He turned off his radio, which was in any event unable to compete with the bass booming from the sport ute in the next lane.

The Old Executive Office Building was as far as Kyle got that day—or the next one. About the time he'd traded witticisms with the driver of the Toyota pickup, the emissaries of the Galactic Commonwealth had announced their imminent arrival on Earth by interrupting the TV broadcast of *A.M. America.*

The White House situation room held the humidity and stench of too many occupants. Men and women alike had lost their jackets; abandoned neckties were strewn about like oversized, Technicolor Christmas tinsel. Notepad computers vied for desk space with pizza boxes, burger wrappers, and soda cans.

In clusters of two and three, the crisis team muttered in urgent consultation. A few junior staffers sat exiled in the corners, glued to the TV monitors. Everything was being taped, but everyone wanted to see the aliens' broadcasts live. Watching a new message, even if it differed not a whit from the last twenty, provided momentary diversion from the

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many uncertainties.

Neither Kyle's Palm Pilot nor the remaining pizza had wisdom to offer. He looked up at the entry of Britt Arledge, White House chief of staff and Kyle's boss and mentor. The president's senior aide could have been a poster child for patricians: tall and trim, with chiseled features, icy blue eyes, a furrowed brow, and a full head of silver hair. Within the politico's exterior sat a brilliant, if wholly unscientific, mind. Arledge's forté was recognizing other people's strengths, and building the right team for tackling any problem.

Kyle wondered whether his boss's legendary insight extended to the Galactics.

"So what have we got?"

He parted a path for them through the crowded room to the whiteboard where he'd already summarized the data. The list was short. "Not much, but what we do have is amazing.

"The moon now has its own satellite, and it's two-plus miles across. Not one observatory saw it approaching. Once the broadcasts started and people looked for it, though, there it was."

Arledge had raised an eyebrow at the object's size. The NASA-led international space station, two orders of magnitude smaller, was still only half-built. "But they can see it now."

Kyle nodded. "It's big enough even for decently equipped amateur astronomers to spot." Far better views would be available once STI, the Space Telescope Institute in Baltimore, finished computer enhancement of various images. Too bad the super-sensitive instruments on the Hubble Space Telescope would be struck blind if it looked so close to the moon. "To no one's great surprise, it doesn't look like anything we've ever seen. Or ever built. The way that it simply *appeared* suggests teleportation or subspace tunneling or some other mode of travel whose underlying physics we can't begin to understand."

"What else?"

"You've seen the broadcasts, obviously." At Britt's shrug, Kyle continued. "That's a pretty alien-looking alien. Also, White Sands, Wallops, Jodrell Bank, and Arecibo *all* confirm direct receipt from the moon of the signal that keeps preempting network broadcasts. Overriding network satellite feed, to be precise.

"So far, that's it. I suspect we'll know a lot more soon."

"Commercial," called one of the exiles.

At the burst of typing that announced redirection of the signal, everyone turned forward to the projection screen. A famous pitchman vanished from the display almost so quickly as to be subliminal (it was enough to make Kyle think of Jell-O), to be replaced with the increasingly familiar visage of the Galactic spokesman. No one could read the expression on the alien's face, not that anyone knew that the aliens provided such visual cues, but Kyle found himself liking the creature. What wonderful wit and whimsy to present their announcements only during the commercial breaks.

"Greetings to the people of Earth," began his(?) message. "I am H'ffl. As the ambassador of the Galactic Commonwealth to your planet, the beautiful world of which we were made aware by your many radio transmissions, I am pleased to announce the arrival of our embassy expedition. We come in peace and fellowship."

Kyle studied the alien's image as familiar words repeated. The creature was vaguely centaurian in appearance: six-limbed, with four legs and two arms; one-headed; bilaterally symmetric.

Any resemblance to humans or horses stopped there. His skin was lizard-like: faintly greenish, hairless, and scaled. The legs ended in three-sectioned hooves; the arms in three-fingered claws better suited to fighting than to making or manipulating tools. A wholly unhorselike tail—long, muscular, and bifurcated, with both halves prehensile—appeared to provide counterbalance to the elon-

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gated torso. The head had four pairs of eyes, with a vertical pair set every ninety degrees for 360° stereoscopic vision. A motionless mouth and three vertically co-linear nostrils appeared directly in the torso. The best guess was that H'ffl both spoke and heard through tympanic membranes atop the head.

"Our starship has assumed orbit around your moon. Two days from today, at noon Eastern Standard Time, a landing craft will arrive at Reagan National Airport in Washington, DC."

The control-tower radar at Reagan National tracked the spacecraft from well off the Atlantic coast to touchdown. The blip was enormous: the "landing craft" was larger than an Air Force C-5 cargo carrier. (That heavy-lift air transport had been dubbed the Galaxy . . . how ironic, Kyle thought.) Fighters scrambled from Andrews AFB reported a lifting-body configuration: a flattened lower surface in lieu of wings. The turbulence behind the spacecraft, visible to weather radars, suggested powered descent.

The spacecraft swooped into sight, following the twists of the Potomac River as agilely as a radio-controlled model plane. The Air Force officer to Kyle's right scowled. "What's the matter, Colonel? You'd rather they fly over the city?"

"I'd rather that their ship wasn't so maneuverable."

Comparing capabilities? Kyle recalled the enormity of the mothership in lunar orbit, and stifled a laugh.

Civil air traffic had been diverted to Dulles International; the Galactic vessel shot arrow-like to the center of the deserted field, settling onto the X of two intersecting runways. A mighty cheer arose from the throng that nothing short of martial law *might* have kept away. The shouts faded into an awkward hush as thousands realized that nothing was happening.

Kyle hurried to the tower elevator, descending to join the coterie of welcoming dignitaries. They were already boarding the limos that would drive them to the Galactics' vessel. He wound up in the last car, between a deputy under-secretary of state and an aide to the national security advisor. The woman from Foggy Bottom studied papers from her briefcase.

Stepping from the car, Kyle obtained some new data: the concrete beneath the landing legs of the spacecraft was broken. That thing was *heavy*. The shout of greeting must have drowned out the report of the runway cracking.

The welcoming party formed two concentric arcs facing the spacecraft, heavy hitters up front, aides and adjutants in back. Kyle took a spot in the second tier, vaguely pleased with his position: his craning at the ship was less obtrusive this way.

Away from the crowd, only the creaks and groans of the ship cooling down from the heat of reentry broke the silence. The sun beat down unmercifully. Kyle tried to memorize details of the ship—shape and proportion, aerodynamic control surfaces, view ports, thrusters and main engines, antennas—even though photographers around the airport and in helicopters overhead were busily capturing everything with telephoto lenses. Sensors hastily installed in the limos were measuring and recording any radiation from the ship.

His overriding impression was one of age, that this ship had been around for a while. Why? After a moment's thought, he focused his attention on the skin of the ship. Under the cloudless noon sky, not a bit of surface glinted. He wasn't close enough to be sure, but the shadowed underbelly of the ship seemed finely pitted. How many years of solar wind had it withstood? How many collisions with the tenuous matter of the interstellar void? Beside him, the diplomats were absorbed in their own unanswered, perhaps unanswerable, questions.

And then, at long last, with soundless

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ease, a wide ramp began its descent from the underside of the alien ship.

CHAPTER 2

The ramp struck the concrete runway with a solid *thunk*. The walkway faced about twenty degrees away from the crowd, a shallow enough angle that no one moved. Necks twisted and craned slightly towards the shadowed opening. An inner door—an airlock port?—remained closed.

Kyle snuck a peek at the meter in his pocket. The counter showed an increase in radiation levels since the ramp had descended, but not enough to worry about. Still, he chided himself for losing the argument that the welcoming party wear dosimeters. That battle lost, he'd done the best he could: the meter in his coat would beep if his cumulative exposure exceeded a preset threshold.

Inference one, he thought, eyeing once more the cracked runway. Radiation plus massive weight, enough weight for a *major* amount of shielding, denote nuclear power. Then a sharp intake of breath from the diplomat beside him returned Kyle's attention to the ramp. As he watched, the airlock door cycled silently open.

Four aliens cantered down the incline, their scales iridescent in the sunlight. The ramp boomed under thudding hooves, with a tone that reminded Kyle of ceramic. The creatures halted on the runway at the base of the ramp. For clothing, each wore only a many-pocketed belt from which hung a larger sack like a Scottish sporran. Only slight variations in skin tone, all shades of light green, differentiated them. Each had about twelve inches on Kyle, himself a six-footer.

The aliens didn't turn towards the human dignitaries. If rude by human standards, the position nonetheless made sense: a face-to-face stance would have given a good view to only one pair of eyes. They're not human, Kyle reminded himself. For them to act like us would be strange.

One of the aliens walked slowly towards the awaiting humans. Pads on the bottom of his hooves rasped against concrete. Extending both arms, hands open, palms upward, the alien stopped directly in front of Harold Shively Robeson.

"Thank you for meeting me, Mr. President," said the creature, the bass voice rumbling eerily from the top of his head. "I am Ambassador H'ffl. I bring you greetings from the Galactic Commonwealth."

The president reached out and clasped one of the alien's hands. "On behalf of the people of America and planet Earth, welcome."

So many mysteries; so little time.

Kyle stood in the White House basement command post of the science-analysis team. There was no place on Earth he'd rather be, except possibly upstairs in the Oval Office where the president and sundry diplomats met with the F'thk themselves. Should he be *here,* helping to make sense of what data they already had, or *there* trying to gather more? The obvious answer was: yes.

"How's it going?"

He'd been staring at a wall covered with Post-It notes. Each paper square bore, in scribbled form, one comment about the aliens. As he turned to the doorway where Britt Arledge had appeared, one of the drafted wizards from DOE did yet another reshuffle of the stickies. Two more squares, green ones, denoting inferences, appeared between the rearranged yellow factoids. One of the relocated squares, its adhesive dissipated by too many moves, fluttered to the floor. A secretary scurried over to rewrite its content on a new sheet.

Kyle gestured over his red-eyed boss, wondering who looked more exhausted. "We're learning."

Britt nodded; it was all the encouragement Kyle needed. "For starters, our guests have a fusion reactor aboard their landing craft. That technology alone

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would be invaluable."

"Is that so?" The response was nearly monotonic; Arledge seemed singularly unimpressed. "The F'thk didn't mention that."

"Gotta be." Kyle warmed to his subject. The meter he'd taken to National hadn't differentiated between types of radiation, but the gear he'd had stowed aboard the limos was far more sophisticated. The drivers, following his instructions, had parked the cars in positions well-spaced around the spaceship. "There's definite neutron flux at the back of the ship and magnetic fringing like from a tokamak quadrupole."

"Uh-huh."

"Magnetic-bottle technology to contain the plasma, and lots of shielding to protect the crew. Tons and *tons* of shielding, Britt. You saw what their ship did to the runway."

"Okay."

"On our own, we *may* have practical fusion in fifty years." Thinking, suddenly, of the distant mothership, two-plus miles across, he nervously ran both hands through his hair. "Momma must have one *big* fusion reactor aboard."

"Oh, I doubt it," said Britt, a cat-who-ate-the-canary grin lighting his tired face. "My friend H'ffl says it uses matter-to-energy conversion. He wondered if we have antimatter."

Antimatter! No wonder Arledge was so unimpressed by his own news. "Fleetingly, for research, and then only a few subatomic particles at a time. Nothing you could power a spaceship with." Or a light bulb, for that matter. A flurry of new Post-It notes suggestive of more progress distracted him. "What was that?"

"I asked, is antimatter dangerous? H'ffl says it's standard practice to park antimatter-powered vessels in the gravity well of an uninhabited moon when near an inhabited planet. Something about protecting against the remote likelihood of a mishap. Does it make sense for them to keep the mothership out by the moon?"

"Yes, it's dangerous, and I don't know. Equal amounts of matter and antimatter *do* convert totally to energy, at efficiencies far greater than fission or fusion. Orbit just a thousand miles above Earth, though, and there's no atmosphere whatever. No friction. Even without engines, a ship would circle forever. If, for some reason, it blew up, there'd be beaucoup radiation, but nothing—I should do some calculations to confirm this—nothing the atmosphere wouldn't effectively block.

"So, no, I don't see any reason to stay a quarter-million miles away. Then, what do *I* know? It's not like Earth has technology remotely like theirs."

The chief of staff persisted. "Is the mothership a danger where it is? What if it crashed on the moon?"

"A really big crater, as if one more would matter. The point is that won't happen. The moon has no atmosphere. Any orbit higher than the tallest lunar mountain should last forever." Kyle had fudged a bit for effect: given enough time, he suspected, gravitational perturbations from lunar mascons or other planets, or tidal effects of the Earth, or solar wind would have disastrous effects on an orbit *that* low. None of which applied, in less than geological time, to the altitude at which the F'thk ship actually orbited the moon. One glance through a telescope had convinced him that the mothership wasn't ever meant to land.

"The president will be relieved."

When had the Post-It notes stretched around to a second wall? "What else can I tell you?"

"Nothing, really—I was mostly making conversation. I actually came by to invite you to dinner." He waved off Kyle's protest. "A state dinner, upstairs, tonight at eight. Perhaps Ambassador H'ffl or one of his companions can enlighten you on F'thk orbital preferences."

Something was odd about the ball-

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room, thought Kyle, something other than the green aliens making chit-chat with Washington's elite. What was it? He settled, at last, on the absence of hors d'oeuvres. The F'thk would not eat in public: they said that trace elements in their food were toxic to terrestrial life. White House protocol officers had then decreed that the humans wouldn't eat either.

Some dinner! He wished someone had mentioned this decision before he'd arrived. He'd gone home to change into a tux; any nuke 'n puke meal from his freezer, if not up to White House banquet standards, still would've beaten fasting.

He sipped his wine; the F'thk with whom he and a gaggle of civil servants were talking held tightly to a glass of water. The micro-cassette recorder in Kyle's pocket was hopefully catching the entire conversation. If not, well, he'd handed out others.

"You've been very quiet, Dr. Gustafson. I'd expected more curiosity from a man in your position."

Kyle needed a moment to realize that the comment had come from the alien. Earth's radio and TV broadcasts had served not only as beacons but also as language tutorials—lessons the F'thk had learned extremely well. "Lack of curiosity is not the problem, K'ddl." Despite his best efforts, a hint of vowel crept into the name. "Quite the opposite. I have so many questions that I don't know where to begin."

"Oh, God," whispered a State Department staffer behind him. "He's going to babble in nanobytes per quark volt."

Kyle ignored the crack, his mind still wrestling with the afternoon's conversation about the mothership. "I'm puzzled about one thing. Why keep the F'thk mothership in lunar orbit? It seems excessively cautious."

Swelling violins from the chamber orchestra—Mozart, Kyle thought—drowned out the alien's response. He shrugged reflexively, realizing even as he did it how foolish it was to expect the alien to understand the gesture.

Except K'ddl did. "I said, it's not F'thk. The mothership is Aie'eel-built. They fly it, as well." The alien made a periodic rasping noise which, Kyle decided, must be a form of laughter. "You thought it coincidental that the Commonwealth's representatives were so humanlike? You would consider the Aie'eel so many headless, methane-breathing frogs. The Zxk'tl and the #$%^&"—Kyle couldn't even begin to organize that last sound burst into English letters—"and other crew species aboard the mothership would seem less human still.

"We F'thk were chosen as the emissary species because we so closely resemble you. We are accustomed to similar gravity, temperature, sunlight, and atmosphere." He hoisted his still filled glass and took a drink. "We are even both water-based."

That was when too much wine on an empty stomach betrayed Kyle. The room spun. His ears rang. Visions of . . . things . . . too inhuman even to lend themselves to description assailed him. All thought of orbits and exotic energy sources fled. He missed entirely the last comment K'ddl made before turning his attention to another White House guest.

The tape recorder in Kyle's pocket, however, was made of sterner stuff. K'ddl had added, "I do not wish to offend, but no F'thk would ever invent such dark nights or such a paltry number of moons."

Two sandwiches and four cups of coffee later, Kyle felt almost himself again. He ignored the disapproving sniffs of the White House chef. It was unclear, in any event, whether the criticism dealt with Kyle's plebeian taste for peanut butter or his part in that afternoon's delivery to the kitchen of so much bulky equipment. So many instrument-covered counters . . . perhaps it was just as well that dinner for three hundred had been canceled.

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A Secret Service agent turned waiter for the evening came through the double doors, a single half-empty glass on his tray. "One of the aliens set this down. K'ddl I think, but I can't really tell 'em apart yet. Sorry it wasn't any fuller."

Kyle nodded his thanks. "Doesn't matter. It's more than we need." He tore the sterile wrapper from an eyedropper, then extracted a few milliliters from the alien's glass. The sample went into an automated mass spectrometer.

The analyzer beeped as it completed its tests. The color display lit up, chemical names and their concentrations scrolling down the screen. Water. Very dilute carbonic acid: carbon dioxide in solution, basic fizz. Traces of calcium and magnesium salts. Kyle compared the list to a sample taken before the aliens had arrived. As best he could tell, the glass contained pure Perrier.

"Kyle?"

He turned to the casually dressed engineer, a friend from the nearby Naval Research Labs, who'd spent the evening in the kitchen. "Yeah, Larry?"

"The *air* samples are different." To an eyebrow raised in interrogation, Larry added, "Check the plots yourself."

Kyle rolled out two strip charts, one annotated "6:05 P.M." and the other "9:00 P.M." Spikes of unrecognized complex hydrocarbons appeared on only the later sheet. If what passed for alien saliva held no trace of metabolic toxins, apparently their exhalations did. Still, the nine-o'-clock spike seemed somehow familiar.

Ah.

"Can I bum a cigarette, Lar, and a match?" He lit up clumsily, almost choking as he inhaled. Waving away the suddenly solicitous engineer, he took a more cautious drag. He directed part of this lungful into a test tube, which he quickly stoppered.

Larry, catching on quickly, ran the latest sample through the mass spectrometer. The resulting strip chart, marked "10:11 P.M.", soon lay beside the others.

The evening's addition to the White House air was simply tobacco smoke. Whatever toxins the aliens ate didn't appear in their breath, either.

Kyle poured a fresh cup of coffee, only in part to wash the unaccustomed and unwelcome smoke residues from his mouth. He also hoped for a caffeine jolt to settle jangled nerves. First, the conundrum about the aliens' inconvenient orbit around the moon; now, undetectable toxins.

He wondered when, or if, his study of the aliens would begin to make sense.

CHAPTER 3

H'ffl Is Father of My Baby—*National Investigator*

UFO Sightings Precede F'thk "Arrival"—*Star Inquirer*

Satyr-like F'thk Are Devil's Spawn—yesterday's most popular dialogue on the Modern Revelations News Group, *AmericaNet*

F'thk Evaluate Earth for Commonwealth Membership—*Washington Post*

Between two parallel lines of the Marine honor guard, a ramp descended from the Galactics' ship. What looked like a hovercraft floated down the incline, any noise that it may have been making drowned out by the crowd. Four F'thk and a large cylindrical object filled the house-sized vehicle's open rear deck. The one-way glass of the front compartment gave no clues as to the species of the driver. From the shortness of the cab, it seemed unlikely that the driver was another F'thk. Then again, maybe there was no driver.

At a stately ten miles per hour, the craft slid across the runway towards the George Washington Parkway. Four Secret Service cars pulled out in front of it; limos and more Secret Service fell in behind to complete the motorcade.

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At that speed, it'd be a while before the aliens arrived here at the Mall. Kyle moved the inset TV window to the back of the palmtop computer's display before turning to his companion.

Darlene Lyons was quietly attractive, with twinkling brown eyes, a daintily upturned nose, and full lips slightly parted in a smile. In faded jeans and an even more faded Metallica T-shirt, her black hair flowing to the small of her back, she looked not at all like the business-suited and bunned diplomat with whom he'd shared a limo to the airport on Landing Day. Then again, it wasn't as if he routinely wore cutoffs, a sleeveless sweatshirt, and an Orioles cap to the OEOB. Alas.

"I'm glad you joined me."

"I'm glad you asked. You were right, too. I'll learn a lot more watching people during the ceremony than seeing it live myself." She raked both hands, fingers splayed, through her lustrous hair. "Though I wouldn't have minded selling my ticket for the grandstands."

Laughing, Kyle tapped a query into the comp. As they watched, the bid on eBay for a bleacher seat popped up another $300, to over fifteen grand. "I don't think the Secret Service would've gone for either of us scalping a seat on the presidential reviewing stand. Besides, this way I'll have something to tell my folks the next time they try to impress me with having been at Woodstock."

Another reason went unstated. For the soon-to-be-appointed head of the soon-to-be-announced Presidential Commission on Galactic Studies, today was probably his last chance to get an unfiltered assessment of the public's mood.

As far as the eye or network helicopters *thp-thp-thp*-ing overhead could see, the Mall was packed. There would be other ceremonies like today's, of course, celebrations all around the world—Tiananmen Square tomorrow, Red Square the next day, Jardin de Tuileries the day after that—but today was different. Today was the first. Kyle and Darlene wanted to be in it, not just watching it. Judging from the crowd, much of the Eastern Seaboard had felt the same way.

He offered an elbow. "Shall we mingle?"

Giving only a snort in response, whether to the anachronistic gesture or the impracticality of walking side by side through the crowd, he couldn't tell, she plunged ahead. He hastened after. Only by heading *away* from the National Gallery of Art, in front of which the Fellowship Station was to be placed, were they able to make slow progress.

"... Growing up as a ..." "... Incalculable opportunity ..." "... Soul-less monsters ..." "... Food around here?" "Devils ..." "To the stars?" Bits of conversation rose and fell randomly from the milling, murmuring crowd.

Devils and monsters? "Wait a sec." Kyle pivoted slowly, listening in vain for more of one conversation. "Did you hear someone mention monsters?" She shook her head.

He dug the computer out of his pocket. A few finger taps retrieved the sampling of today's headlines that had been radio-downlinked from the White House's intranet. He grunted as the tabloid headlines rolled into view. He'd come here to learn, and he had: however inventive these nutty headlines were, there really were people who believed them. A double tap on the AmericaNet entry made him blink in surprise: 547 postings just yesterday to the Modern Revelations news group. A quick scribble with the stylus across the touch screen, "f'thk OR alien OR galactic" matched only 403 of these entries; "monster OR creature OR devil OR demon OR satan" yielded 516 entries. Wondering if he'd missed any synonyms, Kyle wrote himself a softcopy note to check out this news group.

A roar arose from across the Mall. The crowd pivoted towards the National Gallery, aligning itself to the north like

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so many iron filings. People all around them retrieved their radios, portable TVs, and pocket comps. As one, they turned the volume settings to max.

Once more, the aliens had arrived.

The hovercraft coasted gracefully to a halt at the presidential reviewing stand. A ramp slid from the deck area. A F'thk (Kyle couldn't decide from the small screen if it was one that he'd met) guided the cylindrical Fellowship Station down the slope. No longer partially obscured by the side of the hovercraft, the cylinder could now be seen to have a flared base, a skirt for containing its own air cushion, perhaps. To yet one more cheer, the cylinder settled to rest on the grassy surface of the Mall.

As the president completed his words of welcome and introduction, Darlene poked Kyle with a sharp finger. "Coming to Washington first. Odd, don't you think?"

His home VCR was taping everything anyway. "So? They'll see other capitals, meet other heads of state at other ceremonies, starting with Chairman Chang tomorrow in Beijing."

"They've picked favorites, or seemed to, by coming to Washington first. Why not New York and the UN?"

"Maybe they didn't know about it."

"Yeah, right. They speak perfect English—and French, Spanish, German, and Russian. People I respect say their Mandarin, Japanese, and Hindi are just as good. They made themselves folk heroes by interrupting only commercials. You really think they never heard of the United Nations?"

"You don't buy that?"

"Hardly."

"Does everyone at Foggy Bottom feel this way?"

Her look of disgust was eloquent.

So . . . someone who didn't take the aliens at face value. Someone whose thinking was, at the same time, orthogonal to his own. Kyle made a snap decision. "Congratulations."

"For what?"

For being selected a member of the Presidential Commission on Galactic Studies. Trying to look enigmatic, he turned back to his computer screen, on which Ambassador H'ffl had just appeared.

"Ask me tomorrow."

After speaking of fellowship and galactic unity for fifteen minutes, Ambassador H'ffl extended an arm toward the just-dedicated Fellowship Station. In one smooth motion, a talon sliced through the ribbon and depressed the single control button. The crowd didn't go silent, that was too much to expect from what the media now estimated at 720,000 people, but there was a decided abatement of the din. An inset door in the station slid aside. H'ffl removed something that sparkled in the sunlight and handed it to President Robeson.

"On behalf of the Commonwealth, I offer you this orb, symbol of galactic unity. May the peoples of Earth soon qualify for membership."

Renewed shouting drowned out much of the president's response. As Kyle and Darlene watched, H'ffl and his associates presented one orb after another to the assembled dignitaries. A phalanx of Secret Service agents, Park Service police, and DC cops held back the crowd while the VIPs filed back to their limos. Honking as it went, the motorcade receded.

Darlene and Kyle were among the lucky ones: they reached the Fellowship Station and received their orbs in only a bit over five hours. Each was an ever-changing crystalline sphere, resting in a metallic bowl atop a ceramic pedestal. It seemed a nice enough souvenir, if hardly worth the hoopla.

The next morning, an exhausted Kyle found an orb waiting on his desk. The note left beneath the galactic memento read: "When I told H'ffl about your new duties, he insisted that you get one of these. Britt."

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CHAPTER 4

Economic Impact of Galactic Technology Uncertain—*The Wall Street Journal*

Thousands Pray for Deliverance from Space Devils—yesterday's most popular dialogue on the Modern Revelations News Group, *AmericaNet*

Gustafson Commission Opens Hearings Today—*The New York Times*

Aides scurried around the enormous conference table, double-checking the placement of name tags, distributing glasses and pitchers of ice water, straightening network taps and power cords for laptop PCs, and setting out pencils and pads of paper. The secretaries were silent; the considerable noise within the room all came from the milling crowd on the opposite side of the closed double doors. From, that was, the press and the commission members. . . .

The chairman of the Presidential Commission on Galactic Studies scowled at the totally anachronistic pads of paper, and at the inclusion of so many committee members apt to use them. He'd turned out to have less authority than expected—far less, for example, than the president's chief of staff. Kyle could name as many *staffers* as he wished; the *commissioners* were to be chosen more for their political correctness ("A diversity of viewpoints," Britt had gently rephrased Kyle's complaint) than for any insight they were likely to have.

The list of private-sector members on which he and Britt had finally converged was simultaneously top-heavy with CEOs from New New Economy companies and light on technologists: more campaign contributors than researchers. Kyle could at least hope that these executives would tap their organizations' expertise, and he'd had some success in holding out for execs whose firms did relevant R&D. As to the Wall Street and Hollywood types, he could only hope that the deliberations would put them to sleep. Would it be unseemly to ask his token clergyperson to pray for that?

The next largest group of members was drawn from mid-tier executives of key federal agencies and departments: EPA, Energy, NASA, Homeland Security, DoD, Commerce—and State. He smiled, recalling a rare victory: Darlene Lyons was one of "his" diplomats.

The smallest set of slots was for practicing scientists and engineers. With only ten member spots to work with, he'd scoured academia and the federal labs for twenty-first century Renaissance people. *Damn!* He needed biologists, physicists, and engineers of every type; astronomers; psychologists and sociologists; organic and inorganic chemists; economists . . . the list seemed endless, and ten seats didn't begin to cover it. After considerable anguish, he'd filled the few experts' positions. Time would tell what happened when seven Nobel laureates focused on one problem.

The hubbub outside was rising to a crescendo; he caught the eye of Myra Flynn, his admin assistant. She did a final scan of the facilities, then nodded: the room was ready. He nodded back, dispatching her to open the doors.

Let the Galactic games begin.

Squinting under the onslaught of massed videocam lights, Kyle studied the faces arrayed around the table. Despite his earlier misgivings, he had to admit it: the hearing room was packed with achievers and over-achievers, great Americans all. For this mission, it was impossible to be too competent.

It was time to stimulate their thinking. He took a sip of water while he tried yet again to vanquish his stage fright.

"Fellow commissioners." The words came out as a croak. Another sip. "You have all been invited, and have graciously accepted the call, to serve your country at a time when great issues must be

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addressed. Great issues, indeed." He tapped the keyboard built into the lectern. An image popped up on the projection screen beside him, and onto the display of every PC whose owner had logged onto the committee-room network. The still picture was a close-up of the Galactics' highly impressive landing craft. "This is the tip of the iceberg."

Click. A second picture appeared, a telescopic close-up of the two-mile-wide mothership. H'ffl said it was named S'kz'wtz Lrrk'l, which he'd translated as Galactic Peace. "*This* is the iceberg. The civilization capable of building this vessel represents opportunities and risks which, I am convinced, we cannot yet even begin to fathom. It is our responsibility to explore those opportunities, to investigate those risks, and to chart a prudent course between them."

Click. An aerial photo appeared of the Washington Mall, with any trace of grass obscured by the myriad of people patiently awaiting the arrival of the Fellowship Station. "The people of America . . ." Click. A montage of aerial shots of major capital cities around the globe, each showing a sea of citizens greeting the Galactics. ". . . And of the world now look to their leaders in hope."

Click. For the first time, sound issued from the projection system: xenophobic rantings. After a few seconds tightly focused on the contorted face of the charismatic speaker, the camera panned back to reveal a few dozen rapt faces, then hundreds, then thousands. Kyle muted the harangue. "Or they look in fear. Fear of the unfamiliar. Fear of the unknown."

Click. A back-lit close-up of an orb, the instantly famous symbol of galactic unity, the crystal slowly, subtly, hypnotically changing colors and texture. The larger-than-life image emphasized the variations occurring throughout the sphere's crystalline depths: a thing of beauty beyond words. Kyle noticed, for the first time, that several commissioners had brought their own orbs to the session. "Our task, and it is a most challenging one, is to advise the president on whether, and how, to respond to an offer from the Galactics, should one be forthcoming.

"Let us all be up to that challenge."

Chords crashed. Arpeggios rippled their way up and down the keyboard. Speakers all around Kyle poured out music so pure that his fingers imagined the stiff bounce of each key; his shoulders and arms tensed in sympathy with the pianist's.

As the Saint-Saëns second piano concerto enveloped him in its lengthy crescendo, he peered into a Galactic orb. Colors shimmering and swirling throughout its depths drew him ever inward. A lava lamp for the twenty-first century, whispered some quirky corner of his mind.

He'd never seen the orb transform so rapidly. Colors flowed one into another. Textures waxed and waned, one blending imperceptibly into the next. Patterns formed and faded before a merely human intellect could capture their meaning.

The final chords, and some epiphany, seemed to hang in the air, tantalizingly just beyond his reach. As the music stopped, so, too, did the changes within the orb. Sighing, he picked it up from the coffee table. Not for a lack of trying, all that he, or anyone, had learned was that the galactic unity icon responded to light and sound. Like snowflakes, no two orbs were ever quite the same, nor had any orb ever been seen to repeat itself. Fellowship stations kept manufacturing them on demand, requiring only occasional re-deliveries of raw material from the F'thk.

From its cabinet across the living room, the red power LED of the stereo amplifier stared unblinkingly at him like a cyclopean eye. Setting the orb back down, he took up the remote control in its stead. He aimed the remote at the en-

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tertainment center. Zap.

A sea of sound once more immersed man and orb, changing both in ways too subtle to be immediately understood.

Piles of reports lined the back of Kyle's desk; a floor-bound stack leaned precariously against a crammed bookcase. Even today's mound of executive summaries, precisely centered on his blotter, was daunting.

Sweeping sandwich crumbs from the top report, he read the title: *Economic Repercussions of a Switch to a Fusion Economy.* Below that he found *Passive Infrared Analysis of the F'thk Anatomy*, *Means for the Analytical Substantiation of Antimatter Power Systems*, *On the Efficacy of the F'thk Visual Apparatus: a Follow-Up Investigation*, and *Speculations on Interstellar Trade Modalities.*

The top and bottom reports presumed that Earth and the F'thk reached a meeting of minds, and were light years outside his area of expertise. He set those aside to review at home that evening. The middle three showed more promise.

Speed-reading its abstract quickly revealed that *Means for Analytical Substantiation* was an elaborate plea for replacing the replacement Gamma Ray Observatory. He snorted. He hardly needed a presidential commission to tell him that the fingerprint of matter/antimatter energy conversion was gamma-ray production, and that the atmosphere blocked gamma rays. The good news was that a substitute for the satellite lost in the *Atlantis* explosion might possibly, if money were no object, be quickly constructible from the lab prototype. The bad news was that such an orbital observatory, even more than its huge and ungainly forebear, would need the services of a massive booster—the shuttle—for delivery to space.

Oh, the irony of a grounded shuttle fleet when the Galactics came a-calling. The Russians weren't flying manned missions either, although in their case the stand down was due to an ever imploding economy. He wanted *so* badly for Man to be a spacefaring race, even if only skimming the top of its own atmosphere, when dealing with the F'thk. Sans shuttle, the International Space Station had been vacated via its emergency lifeboat.

A fireball in a clear blue Florida sky returned, unbidden, to his mind's eye. One more horrible image, like the glowing streaks of the disintegrating *Columbia*, he knew he could never forget. He set aside the report, grabbing another for distraction.

The IR study of the F'thk was crisp and factual: just what he needed. Several conference rooms used for meetings with the aliens had, at the commission's direction, been instrumented with hidden infrared sensors. Satisfaction with the report faded, however, as he completed the introduction and moved into results. Computer-enhanced images from the sensor data revealed little more than sporadic hot spots in ambient-temperature bodies. Since the visitors seemed equally energetic and equally clothes-free in all Earthly climates, this apparent cold-bloodedness was yet another puzzle.

The low-resolution pictures provided the only anatomical data he had—the F'thk consistently declined all suggestions that they provide biological/medical information. Kyle's rationale for the request, that such data were necessary to avoid any inadvertent endangerment of either species, was politely dismissed. H'ffl asserted full confidence in his guidance from the Commonwealth's scientists. The possibility of a biological incident seemed to amuse him. Beyond keeping their own knowledge to themselves, the F'thk also refused requests to be examined by X-ray, ultrasound, or any other active imaging technique. When pressed, they invariably answered, "Information is a trade good."

Flipping pages impatiently, Kyle en-

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countered more excuses than derived anatomical data. The report ended with the predictable request for supercomputer time for additional image enhancement. "Approved," he scrawled, and tossed it into his OUT basket.

One down.

Visual Apparatus was full of minutiae about F'thk viewing angles and stereoscopic vision. He was about to add this tome to the OUT basket unread when his thumbing-through uncovered a section on separate day-and-night vision systems. "The dilation of F'thk pupils," he read, "indicates that the upper eye of each pair is optimized for day vision, the lower eye for night vision." He reached reflexively for his coffee cup as he began studying the report more closely.

The night-vision data was the result of one of Kyle's suggestions. The F'thk did not approve X-ray imaging—and certainly could carry sensors to tell if their wishes had been ignored—but planning could widen the range of achievable passive observations. After the surreptitious tripping of a circuit breaker, low-light video cameras in a rigged room had caught the pupils of F'thk night eyes dilating with extreme rapidity. Pupil dilation—substantially wider than occurred when lights had been dimmed for a viewgraph presentation—was still in progress when the windowless room had become too black for the high-sensitivity CCD videocams to function.

Faugh. The coldness of the coffee finally registered; he emptied the dregs into the potted plant beside his desk. Pouring a fresh cup from the brewer on the credenza, he wondered what was bothering him. Obviously, their night vision was suited to a moonless world . . .

Moonless. Was *that* the problem?

The text-search program needed only a few seconds and some keywords to find the transcript; K'ddl's words at the White House reception were as he'd remembered. "I do not wish to offend, but no F'thk would ever invent such dark nights or such a paltry number of moons."

He shut his eyes in concentration, a finger marking his place in the report. How likely was it for such ultra-sensitive night vision to have evolved on a planet with several moons?

He didn't know, but that's why the commission had a biologist.

A delightful aroma—basil and rosemary? Kyle speculated—wafted down the State Department hallway. It was, happily, no longer considered necessary to fast in front of the aliens. One week into the commission's existence, a commissioner had fainted mid-session. An amused ambassador, upon learning the cause of the commotion, insisted that the F'thk did not consider it rude for the humans to dine whenever they wished. The aliens themselves needed to eat only once for each of *their* days, about thirty Earth hours. Rather than impede progress by suspending meetings for meals, they would be happy to continue while the humans ate. Really.

A group of commissioners and F'thk strolled slowly down the hall towards one of State's many dining rooms. Kyle's stomach rumbled as they approached the food, though from nerves rather than hunger. He was, for the first time, deviating from the visitors' explicit wishes. His right hand, hidden in his pants pocket, fondled a tiny ultrasonic beacon; the gadget, when triggered, would pulse once at a frequency to which a previous test had shown the aliens unresponsive. The isolation of a suitable frequency had required some experimentation—it had turned out that the F'thk communicated among themselves by modulated ultrasound, using a language human scientists had made zero progress in analyzing.

The hall narrowed where two china closets had been retrofitted. Behind the wooden doors on both sides of the cramped passageway were the newest and most sensitive ultrasound imagers that money could buy. A F'thk named

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Ph'jk was in the lead; as he entered the space between the hidden instruments, Kyle squeezed the hidden signaling device.

It happened too fast to register. Ph'jk reared up on his hind legs, lashing out with his front hooves at the right-hand doors. K'ddl galloped forward, squeezing into the narrow space to shatter the doors to the left. Within seconds, slashing claws and pounding hooves reduced wood and electronics alike to splinters. Ignoring the sparks and wisps of smoke rising from the wreckage, the F'thk continued wordlessly into the dining room. Splintered wood crunched beneath their hooves as they crossed the wrecked area. Dazedly, the humans followed.

H'ffl set a claw, talons retracted, on Kyle's shoulder and squeezed. "Information is a trade good," he said. "We trust you will not attempt again to steal it."

Kyle wiped a swatch of condensed steam from his bathroom mirror. The long, hot shower hadn't done much for his shoulder or his mood; he scowled at his bruised reflection. A sore shoulder was all he had to show for yesterday's escapade.

The ultrasound equipment had been ruined beyond hope of recovery of any internal images of the aliens. Should've networked the damn machines, he thought, hours too late. The data would've been out of their reach before they had the chance to react.

Or maybe not. Over his first cup of morning coffee, he called the commission staff desk to confirm his suspicions. Passive sensors also hidden in the hallway had revealed three other ultrasound sources to have been present: each of the F'thk had apparently carried a jammer. It wasn't a *big* surprise: the immediate response proved that they'd been carrying detectors; why not jammers, too?

He'd brooded all night for nothing. There had been no lost opportunity to have spirited away stolen imagery by network before the alien reaction. Sighing, Kyle headed to his office and the staff's overnight report on the incident, at once eager and reluctant to read what else he'd missed.

The private-sector commission members had largely disappeared with the opening session's TV lights—to return when the cameras did. Glory came of being named to the commission, not in serving on it. Staffers were more than happy to fill in for the vacant members.

The latest gathering in the committee room resembled the colloquium of scientists, engineers, and policy makers he'd expected in the first place. For at least the hundredth time since joining the administration, he decided Britt was dumb like a fox. He was also, to Kyle's unspoken chagrin, sitting in today—bosses have prerogatives. So far, Britt had been a silent observer.

"Here's what we've got." Kyle gestured at nothing and no one in particular. "Clean, essentially limitless, fusion power, the technology for which they'll swap before they leave in return for downloads from our public libraries—if we've voted to join the Commonwealth. They will sell only to governments, who can then license fusion to power-generation companies. Their reasoning is that government control will minimize disruptions to the economy.

"Point two. If a . . ."

"Wait," called Darlene. "Why not license fusion just once, through the UN?"

Fred Phillips from Commerce rolled his eyes. "Give it a *rest*. The Galactics choose not to deal with the UN, and they don't want to talk about it. Besides, I like the precedent: we have far more to dicker with than most countries."

"And it doesn't strike you as odd that a galactic commonwealth, talking planetary membership, is practicing national divide and conquer?"

"Objection noted," interrupted Kyle. He agreed with Darlene, but knew no

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one else did. Majority opinion, led by Commerce, was that bypassing the UN eliminated a human cartel. Just shrewd business.

"Point two. If a majority of nations," he gave Darlene a warning look, "ask to join the Commonwealth, the F'thk say they'll submit Earth's petition. Membership, as far as any of us can tell, appears simply to regularize the trade relationship."

Krulewitch from MIT spoke without looking up from his palmtop computer. "I thought we were still being evaluated."

"We are." Kyle fidgeted with the laser pointer someone had left on the lectern. "The petition will be accompanied by their own report about our suitability."

"Then isn't the fusion-for-library-access trade a conflict of interest? And they won't let us send our own ambassador?"

"Yes, and no way. Not only can't we send an ambassador, we can't set foot on the landing craft, let alone the mothership." Kyle rubbed his cheek ruefully. "I've asked for *that* privilege a dozen times. They always change the subject."

"Antimatter production?" asked Krulewitch.

"A flat no. K'ddl suggested that a species stuck on one planet shouldn't use the stuff." Playing the Galactic, Kyle changed the subject, ignoring the MIT physicist's knowing grin. K'ddl's answer rubbed salt in a still open wound. "Point three: there are lots of loose ends and seeming contradictions, none of them having any obvious bearing on whether this august body recommends a US vote for joining the Commonwealth."

He rattled off some of the more vexing observations. The apparent over-conservatism of the mothership's lunar parking orbit. The ducking of most questions. The unwillingness to let human biologists examine the F'thk. The inexplicably good F'thk night vision. The absence of trace toxins around the F'thk, despite the claimed toxicity of their food. The failure of air filters to capture any hint of the F'thk organic chemistry. The . . .

"Their playing countries off one another," piped in Darlene.

"Point four," called out an under-secretary from Energy. She gave a nasty edge to her voice.

Kyle set down the borrowed pointer. He paused to make eye contact with everyone in the room. "Three points are all. Trade is a good thing, and they know things we'd like to learn. Commonwealth membership would help us trade. The longer we study them, the less I, for one, understand them."

Britt Arledge spoke for the first time that session. "Then I should anticipate the full commission recommending an application for membership?"

Across the room, heads of commissioners and staffers alike bobbed yes. All heads but two: his and Darlene's.

What was so bothering him that he'd pass up the secret of practical fusion power? That he'd risk never knowing what marvels Earth and the aliens could next agree to share? Even if he *could* convince the commission to say no, what was his justification?

"Kyle?"

Feeling that he'd failed, but not knowing how or why, Kyle was reluctant to meet his boss's gaze. Instead, he found himself peering into the galactic orb that sat on the table in front of Arledge. Not sure to which of them he was speaking, Kyle finally and unhappily answered. He willed his voice to be firm.

"So it would appear."

CHAPTER 5

President Lauds Galactic Commission Recommendation—*USA Today*

Protect Earth's Information Birthright—yesterday's most popular dialogue on the Modern Revelations News Group, *AmericaNet*

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Chernykov Denounces Western Cultural Imperialism—*Moskva Daily News*

Gustafson Quits Galactics Commission—*Washington Post*

Cleaning out an office, Kyle mused, wasn't the chore that it used to be. Those of his files that could be retained, he'd copied over the Internet to rented mass storage. He'd download them onto longer-term storage once he started at the new job.

His physical possessions fit in one box: favorite desk accessories, pieces of executive fidgetware, and framed photos of himself with dignitaries he'd met as science advisor. In the last category was a picture with Harold Shively Robeson, shot at Kyle's swearing in; it memorialized the first and last time he'd met the president.

On top of everything else, he set an orb. "What secrets do you keep?" he asked, gazing into its shimmering depths. Like everything else Galactic, it kept its opinions to itself.

The Palm Pilot in his coat pocket chose that moment to chime, announcing an incoming call. The screen revealed the familiar face of his Russian counterpart. Ex-counterpart. "Hello, Sergei Denisovich."

"Good morning, my friend. I'm glad I caught you."

Kyle set the palmtop on the now-bare desk where its camera plug-in could capture him. "At least you're not a reporter."

"Still, I wish to know why you did such a stupid thing."

"Take a number, Sergei." The Russian waited silently for more of an answer. "Oh, hell, Sergei, why *not* tell you? There are too many things about the F'thk I don't understand. Most of the commission wanted to move now, locking up the secret of fusion; I wasn't ready yet."

"We simple Russian peasants are new to this democracy business, but don't people get to vote their consciences?"

"I did, by leaving the commission. It was pretty clear what the administration wanted." Kyle grimaced. "There are also rules about how much, and just plain how, a political appointee embarrasses the president who named him."

"Deciphering politics in Moscow is difficult enough; I'll leave you to sort out the rules in Washington." As the Russian spoke, the picture briefly broke up. When the image returned, Sergei was smiling sardonically. "Well, my friend, at least we will always have Canaveral. As to your future endeavors, I wish you luck."

They chatted a bit more, mostly about Kyle's imminent return to his pre-Washington position—he'd resigned as the presidential science advisor as well as from the commission—but the conversation never quite homed in on a real topic. Kyle wondered just why the Russian had called.

That mystery was replaced with a new one when, by then in his soon-to-be-vacated apartment, Kyle checked his e-mail. Judging from a timestamp, the bad transmission during Sergei's call had somehow registered as an incoming message—and it was all garbage, of course.

His mind would not let go the conversation. What an odd phrase: *deciphering politics.* Could this be an encoded message?

Like many Internet users, Kyle had posted half a pair of encryption keys to a public key-management server. Anyone could send him a confidential message by encrypting it with this public key; only Kyle, using his private key, could decrypt it. He ran the "message" through his e-mail reader's decrypter and got different garbage.

This is foolishness, he thought—a diversion from the serious packing the DC apartment yet required. The Cold War had ended years ago; did he really suspect his Russian colleague of practicing intrigue? Still, their conversation nagged

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at him. *We will always have Canaveral.*

Academic cryptologists had decried the government-sanctioned encryption algorithm as breakable; cynics claimed that Washington wanted the ability to eavesdrop. Did Sergei share such fears? Was Sergei telling him that the Russians had broken the code?

Or was Kyle simply paranoid about a burst of static that had confused his comp?

A web query revealed *ziplock* to be the hacking community's secret-key algorithm of choice. He downloaded an executable for the alternative privacy software from a file server.

Kyle was relieved when the key *Canaveral* failed to decrypt the message. He had no better luck with *Atlantis*, with any of the crew names, or with the date of the explosion. "Get a life," he told himself; his self, instead, tried again with "Apollo/Saturn V" as the key. The ziplock decrypt program now revealed:

I don't trust the F'thk either.

P. A. Nevsky

Another net search explained the vague familiarity of the alias. Prince Alexander was an early Russian military hero, dubbed Nevsky for his defeat of Swedish invaders on the banks of the Neva River. Alexander later reached an accommodation with the conquering Mongols, a deal with the devil that maintained a degree of Russian autonomy.

Was Sergei likening the F'thk, some Russian faction, or the West to the barbarian Mongols? Retrieving a morning headline that his news filter had culled for him, Kyle hyperlinked to the Russian president's polemic about spiritual pollution from encroaching Western values. Chernykov's speech blasted the very idea of F'thk using decadent Western culture to represent humankind to the Galactic Commonwealth.

Multimedia client software in his palmtop subverted to accept an e-mail message transmitted surreptitiously as static during an international video call—a capability that the Russian intelligence service surely didn't want known. The equivocal subtext about a compromised (but by whom?) public encryption system. The ambiguous alias. Russian nationalist hysteria.

The mind boggled.

Amid the expanding set of questions, Kyle clung to one certainty: a peer whom he deeply respected shared his own distrust of the F'thk.

In public life, one has contacts and associates. In politics, balloons drop by the thousands at nominating conventions and are otherwise unseen. In government, banners bear simplistic slogans writ large in standard fonts.

At Franklin Ridge National Labs, Kyle's once and future employer, the cafeteria brimmed with dozens of old friends, hundreds of balloons, and a mildly bizarre welcome banner obviously plotted by a fractal program. He wondered why he'd ever left.

Full of punch—spiked, his spinning head told him—and sheet cake, he let himself be led to his new office. The path chosen by Dr. Hammond Matthews, Kyle's friend, guide, and successor as lab director, began to look suspicious. "Hold it, Matt. We're heading for the director's office."

"Not so," Matt dissembled, nonetheless leading the way to Kyle's former office. Matt gestured at the door, which read: Office of the Director Emeritus. "The director, that poor, benighted bureaucrat, parks himself one aisle over. Some carefree researcher with a fat, unencumbered budget hangs out here." Kyle was seldom speechless, but finding this such an occasion, he threw open the door and went inside . . .

. . . Where he was even more surprised to discover Britt Arledge standing. Matt shrugged apologetically, and closed the door from the outside.

"Good man, that," began Britt.

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Kyle pointed to a seat, then settled into the chair behind the old, familiar desk. He could've taken another spot at the conference table; his anger led to the unsubtle reminder that he no longer worked for Britt. "Miss me already?"

"I have work for you already."

Kyle had been in Washington too long to lose his temper with one of the most powerful men in the administration. Lest that temper escape confinement, he kept his answer short. "Oh?"

"Did you plan to spend some time here studying our F'thk friends?"

Kyle spared the barest hint of a non-committal nod.

"Then $50 million of the black may prove helpful."

Black money: intelligence-agency funds. A lot of it, and from a budget which by its very nature was subject to the most minimal of oversight. He considered various possible answers before settling for the simplest. "Thanks." As silence stretched on uncomfortably, he added, still in a monosyllabic mode, "Why?"

"In case you're right." Arledge took a cigar from his jacket before continuing; failing to spot an ashtray, he sniffed the cylinder longingly before putting it back. He climbed to his feet. "Since I mean us to get fusion before the Russians do, I needed America's best talent to find out."

The Russians again. Essential as news filters were, they had their down side: when you were too busy to follow what was happening, you didn't know to update them.

Wondering what, if anything, about the Alexander Nevsky message to mention, Kyle almost missed the subtext. Almost. "You wanted me off the commission. You pushed." This time, he left the *why?* unstated.

"I needed you here. You can't act nearly as convincingly as you can storm off in high dudgeon. QED."

He should be furious at the manipulation, Kyle thought, but somehow he wasn't: he'd rather be here than Washington. "Sometimes I marvel that you never ran for president."

Britt arched an eyebrow by an understated millimeter. "I didn't have to," he said.

CHAPTER 6

Russia Protests U.S. Arms Sale to Ukraine—*NBC Moscow Bureau*

Treasury Threatens Cutoff of Loans to Russia—*Voice of America*

Nationalists Favored in Russian Federation Elections—*CNN*

There could be very few matters more pressing than interstellar visitors and their advanced technology, but a foolish humankind seemed to have found one: a return to nuclear madness.

Bellicose speeches and resurgent Russian nationalism were bad enough; now Kyle found himself immersed in a far scarier nightmare. As world tensions inexplicably climbed, the White House asked him to spearhead Franklin Ridge's 'round-the-clock research into a national-security disaster: the rash of failures in "national technical means," diplomat-speak for spy satellites. If, as everyone suspected, the Russians were killing the satellites, how were they doing it? And why?

And what would happen when, despite the nation's best efforts to build and launch replacements, America found herself blind?

Franklin Ridge National Labs nestled into a secluded and pristine fold of the Allegheny Mountains. The location was isolated, but still an easy drive from many East Coast cities.

National crises do not recognize weekends, but Kyle took one anyway. The data made no sense. He needed an outside, fresh perspective, and he knew where to find it. And from whom.

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Darlene Lyons had stayed on the Galactic Studies Commission when he'd left. "Someone," she had opined, "has to champion reality there." He remembered the words, and hoped that they would generalize to his new problem, as he rang the doorbell of her Georgetown duplex.

After a welcome hug and some pleasantries, he wound up perched on the front edge of a sofa, picking at crackers and cheese. He picked, as well, at words, unsure how much to say even as he reminded himself that he had invited himself over.

"Is there a scintilla of a reason for you to be here?" She studied him over a glass of Chablis.

Scintilla was the compartmented code word for the top secret satellite investigations at Franklin. Startled, he almost spilled his own drink.

"So much for the theory that my innate charms brought you." Setting down her glass, she stacked a napkin with crackers. "Yes, I'm cleared for Scintilla. What about it?"

"You know that the spysats have been killed with x-rays?"

She nodded.

"A couple of the birds were grazed by the beam before getting fried. The final telemetry lets us approximate the power density of the beam as it locks in." He'd reached the part of the analysis that most upset him; he drained his glass and with a trembling hand poured a refill. "I don't believe that the Russians—or anyone here on Earth—could generate that beam. I think the F'thk are meddling."

Settling next to Kyle on the sofa, she laid a hand on his elbow. "We think so, too."

"The commission?"

"State." It was now her turn to look uncomfortable. "I don't have a code word to exchange for this one. Just keep it to yourself.

"According to H'ffl, the Galactics have their own factions. It's been centuries since the Galactics last discovered a new species possibly eligible for membership. For all that time, their Commonwealth has been evenly split between more-or-less authoritarian states and more-or-less democratic, individual-rights societies. That the nations of Earth are split between the two philosophies has thrown the Galactics for a loop: neither side feels comfortable about how we'd affect their power balance. Earth was almost not contacted for that reason.

"The F'thk are basically libertarian, in the individualist camp; that's why they came first to Washington. H'ffl has told several American diplomats, me among them, of his biggest fear: he has reason to believe one of his legation is an agent for an authoritarian species. He is not sure which, and he doesn't think it's important. What does matter is that the statists are determined to assure their side a majority—and they will do *anything* to avoid a defeat."

Kyle rubbed his chin thoughtfully. "So this alien spy is behind the nationalist authoritarian resurgence in Russia? They want to tip Earth's balance of power to tip their commonwealth's?"

"There's no direct evidence the Russian situation isn't a homegrown political phenomenon. It's far from uncommon for beleaguered parties in power, or those who want to assume that power, to look for a foreign enemy and play the nationalism card. The scary question is: will alien chicanery cause the Russians to do something foolish?"

"The Galactic authoritarians may win if the nationalists take back Russia. They avoid losing, in any event, if the Earth immolates itself."

"That's how it looks," Darlene agreed.

"How's the US commission stand on this? Other countries? Should we ask the F'thk to leave?" Which is not to say they would necessarily honor such a request.

"Won't happen." She shook her head. "Everyone's afraid that the last guy seen got the latest techie favor from them. So every country except the last one visited

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wants the F'thk to stay long enough to see *them* again."

"And every new stopover ratchets up the anxiety level that much more." He drained his wine, unable to see any escape from the dilemma.

Hammond Matthews was a belt, suspenders, and Krazy Glue sort of scientist—his findings, however counter-intuitive, were thoroughly tested before he ever verbalized them.

Matt sprawled the length of what had been, until recently, his own sofa in his own office. With a shoulder-length mane of blond hair, strong jaw, pale blue eyes, and absolutely no hint of a tan, Matt looked like a vampire beach bum. He wore chinos, a knit shirt, and sandals, his one suit and tie stored until the next Washington visitor arrived.

"Heart attacks," echoed Kyle cautiously. When he had asked Matt to search for interesting correlations with Galactic activities, he'd not expected medical coincidences.

"Heart attacks," confirmed Matt. "Every city hosting a Fellowship Station shows an increase."

"Unfortunate, but surely a natural-enough response to the excitement. I was on the Mall, you know, when they came to DC."

"In every case, the pattern began days after the visit. Interestingly, pacemaker failures account for most of the increase."

Kyle caught the implication—he remembered the warning plaques on early microwave ovens. "Orbs don't emit microwaves, or any RF. Commission physicists monitored orbs from the day after I got my first. No orb has ever been seen to radiate anything."

"And I'll bet every one of those measurements took place inside a Faraday cage."

Of *course* the orbs were observed inside electromagnetic shielding. How else could they suppress . . . external signals . . . that could interfere. . . .

Spotting the LED of enlightenment over Kyle's head, Matt climbed to his feet. "Let's step down to the radiometry lab."

Radiometry was a windowless room whose walls, floor, and ceiling hid a lining of grounded copper foil. With its metal door closed, the entire lab was a Faraday cage. Around the room, antennas of every description stood in stork-like vigil. Orbs, in various states of disassembly, were everywhere—not that dissection had explained anything. ("No user serviceable parts," he thought inanely.) In three corners, frameworks of two-by-fours covered with fine-mesh copper screening enclosed smaller test spaces for the conduct of precision experiments.

The workbench along the back wall supported a parabolic antenna aimed at an intact orb. A power cable snaked from the dish antenna's blocky base to a power supply on a lower shelf. Thinner signal cables connected several small dipole antennas arrayed around the orb and around the parabolic dish to a rack of instrumentation.

"We could approximate the carrier frequency from the sensitivity of pacemakers, but it was trial and error to find a signal coding to which the orb responded—if we weren't simply imagining things." Matt rested a hand on the test rig. "Courtesy of your commission's observations, at least we knew that the F'thk favor phase-modulated transmission. The control computer ran through twenty-odd thousand permutations before finding a pulse sequence to which the orb responded."

At Kyle's eye level on the instrument rack, the screen of a digital storage oscilloscope showed two flat traces: no signals in or out. Kyle took a deep breath. "Show me."

A mouse click triggered the beamcast; the lines on the DSO screen instantly mutated into complex waveforms. A bit of typing made the computer translate both phase-modulated signals into the

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more familiar format of binary pulse trains.

Whatever the orb had to say took lots of bits.

CHAPTER 7

"You've got fifteen minutes," said Britt Arledge. "Since the world is coming apart at the seams, be happy for that."

The White House office was spartanly furnished and fanatically organized. For once, Kyle appreciated the obsessive order—it made it that much easier to spot the Galactic orb he felt certain would be present. He quickly spotted one on a bookshelf beside the room door.

He sidled to one end of Britt's desk, blocking with his back the line of sight between Britt and the orb, before taking from his pocket a folded sheet of paper. Raising the other hand to his mouth, he made the universal "shh" gesture.

Britt read the note without visible reaction. "You know, I feel like some coffee. Care to join me?"

They went instead, Kyle leading the way, to a previously arranged cubbyhole in the next-door Old Executive Office Building. The room had a table, two chairs, a PC, and *no* orbs. "Thanks for bearing with me."

"Telling me my office is bugged is a surefire way to get my attention." Britt sat on the edge of the table. "So who's bugging it, and how do you know?"

"The F'thk, that's who. And you won't like the 'how' any better. The orbs are recording devices."

"Which would mean that every officeholder of any significance in this town is bugged, starting with the president."

Kyle didn't care for the skepticism implicit in *would mean.* Instead of commenting, he popped a CD-ROM into the computer. The PC was Tempest-rated, specially designed to suppress the electromagnetic emissions that—in an ordinary computer—would allow skilled eavesdroppers to recreate the monitor image. On-screen, Hammond Matthews summarized a series of experiments upon orbs.

Every orb that the lab had tested showed the same behaviors. If immersed in an actively changing environment—people moving, music playing—the crystalline depths of an orb also changed quickly. When triggered by the proper microwave interrogation pulse, the stimulated orb had a lengthy response. The same orb, observed by videocam in an empty and silent room, changed its appearance very slowly; when interrogated, it had a short response. The experiment was repeated with consistent results using orbs labeled Washington, Tokyo, Moscow, Beijing, and London—units that Darlene had had embassy staff obtain overseas and ship home by diplomatic pouch. *Everyone* was being spied upon, whatever their political school.

Britt tugged an ear thoughtfully. "If I'm following, these devices are usually inert, passively recording the images and sounds that impinge on them. Only when they get this interrogation signal are they active."

"Right. The recording portion, the crystalline globe, needs no power. Think of it as very advanced, electronically readable film. The readout-and-reply portion in the base, beneath the bowl-shaped antenna, *is* externally powered—it takes its energy from a microwave interrogation signal. Now that we know to look, we've detected such interrogation signals. Orbs are routinely probed in and around all major national capitals—everywhere a 'Friendship Station' was left.

"Better, we can triangulate back to the origins of the triggering signals. Those sources turn out to be satellites. They're radar stealthed, which is why NORAD hadn't noticed them as part of the routine tracking of orbital space junk. They're also very dark, which makes them hard to detect visually even when you know where to look. Still, the satellites soak up a lot of energy from the sun. Infrared instruments on NASA satel-

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lites can spot these satellites easily."

"Can we be sure these aren't Russian or Chinese, or other Earth-originated satellites? Someone working with the F'thk?"

Kyle popped the CD from the computer. "There are no stealth launches—when something blasts off from anywhere on Earth our spysats know it. These birds had to have been deposited directly into orbit from space, not launched from this planet."

"Which brings us to more pressing issues, like the escalating mortality rate of our spysats."

"*Related* issues. We know instantly when our birds get fried, because we're in constant communication. We don't have such immediate knowledge of Russian satellites. It turns out, though, that their spysats are starting to tumble in orbit, as if out of control. More and more of their birds are acting just like our known dead ones."

The tiny room fell silent as Britt struggled to absorb the enormity of these discoveries. At long last, he shook his head sadly. "So the F'thk go from capital to capital spreading suspicions. With bugging devices by the millions spread across the great capitals of the world, they know what buttons to push, and they watch how we all react when our buttons *are* pushed. They're disabling everyone's spysats, which has us and the Russians escalating our strategic alert status—which keeps feeding the distrust. The Chinese don't trust either of us, and now they're on heightened alert, too."

"Yup, that pretty much sums it up."

Britt gave him a hard look. "So why, exactly, are you *smiling?*"

"I'm just glad to have friends in high places who share my sense of the danger."

The video, shot from a distance with a telephoto lens, was grainy and jerky. The voice-over, apart from the raw emotion in the narration, was unintelligible. Neither distraction diminished the horror.

The footage of the spectacular launch and even more spectacular explosion of a Russian Proton 2 rocket had been captured by an enterprising Korean journalist. Debris rained down on the sun-baked steppes surrounding the Baikonur Cosmodrome in Kazakhstan. Kyle could not see the enormous fireball blossom without recalling the *Atlantis*, without a lump forming in his throat.

At Britt's gesture, Kyle muted the sound on the CNN feed. An aide was whispering into the president's ear, something about President Chernykov. Moments later, the Moscow hotline connection was active and on speakerphone. The pleasantries were perfunctory and abrupt.

"Dmitri Pyetrovich, we had hoped that a joint scientific project would help to diffuse the recent tensions. Needless to say, today's fiasco will not contribute to this aim."

"Fiasco?" The booming accompaniment was probably a hand slapping an unseen desk in emphasis. "An *American* fiasco, I say. Your shuttle carried the first version of this satellite, and it blew up. Now one of our most reliable rockets carries a hurriedly upgraded lab model of the same observatory—and again there is an explosion. If you look to assign blame, look to your own people."

"My people tell me it was a launcher failure. . . ."

"Your *spies*, you mean." Another background rumble punctuated the Russian's intense voice. "Our experts are still analyzing telemetry, and have released nothing."

President Robeson scowled at the speakerphone. "Calm down, Dmitri."

"*Don't* tell me to calm down. Judging from past incidents, the Kazakhs are likely to demand some sort of penalty payment from us for supposed environmental damages. The cosmodrome immediately suspended all further launches of the Proton 2 until they complete an investigation, which shuts down our commercial delivery business

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for heavy comsats." There was whispering in the background. "One of my aides wonders if you *wanted* this disaster, even arranged it, to favor your own aerospace companies and their launch-service businesses."

Accusations and veiled insults flew. Leaders of the two great nuclear powers growled and fumed. At last, the president had had enough. "I think we can agree continuing this conversation is not to anyone's advantage. But before we end the call, perhaps you will tell me this, Dmitri. Have your experts found anything surprising in the telemetry?"

There was impatient finger tapping, and an unseen Russian sighed. A new voice, that Kyle recognized as Sergei Arbatov, spoke up. "No. Nothing unexpected. It is all a mystery."

"Damned Russians," snapped President Robeson for the benefit of the orb on his desk. "I need to stretch my legs. Walk with me." He stormed from the well-wired Camp David office, followed by Britt, Kyle, and a Secret Service retinue. Without further comment, he led them into the moonlit Catoctin Mountain woods. The house was soon hidden from sight by the trees. "Give us some space," the president told the chief of the protection detail. The agents faded into the woods, their attention turned outward.

"*Good* show, Kyle."

"Thank you, sir." His mind's eye kept flashing back to cataclysmic fireballs. "I wish I'd been wrong."

"But you weren't," said Britt. "You were right all along the line. The Galactics targeted the Baikonur launch, as you predicted. The arrangements were made by phone and Internet—and surely many of the relevant details were arranged out of range of the damned orbs—so your theory that they can monitor all of our electronic communications is apparently also right."

Kyle retrieved and began to fidget with a pine cone. "When the opportunity arises, thank Sergei." Sergei, who had somehow expedited the launch. Sergei, whose theatrical tone of resignation disguised the agreed upon code phrase: nothing unexpected.

For the Galactics had no reason to suspect what the conspiring human scientists now expected: microwaves. Steerable microwave beams from stealthy satellites, beams that converged on the Proton's fuel tank. Enormous energies focused onto the metal shell of the rocket, metal that instantly conducted the energy as heat to the liquid hydrogen within. Kyle pictured a sealed metal container of gasoline in a microwave oven. First, the liquid heated, expanding and evaporating, until the pressure burst open the container. The pressure-driven spray rapidly mixed with air, to be exploded by the first spark.

Nothing unexpected . . . but microwave-borne sabotage *was* expected. That meant the sensors Sergei was to have secreted on the Proton had, before the explosion halted telemetry, reported back in some innocuous guise the presence of strong incident microwave radiation. Russian-placed sensors read out by Russian telemetry equipment—the latest evidence would surely allay any doubts President Chernykov might have had.

"Dr. Gustafson. Sir?"

He shrugged off the reverie into which excited exhaustion had taken him. A Secret Service woman had emerged from the woods. "Yes?"

"Call for you, sir." She handed him a cell phone.

"Sorry, sir," he told the president. To the phone, he added, "Gustafson."

"Hello, pardner." The voice was Hammond Matthews'. They exchanged a few pleasantries and touched on some routine business, projects on which they didn't mind the Galactics eavesdropping. "Too bad you missed the barbecue."

"Was it big?"

A chuckle. "We had five grills running *hot*. You would have loved it."

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Translation: five stealthed Galactic satellites with a line of sight to Baikonur at the time of the Proton launch had flared on infrared sensors. Which meant they were generating far more power than usual. Pumping out weapons-grade microwave beams, presumably.

"Sorry I had other commitments. But I need to run." He returned the phone to the agent, who disappeared back into the woods.

He brought his walking companions up to date on the final test and confirmation.

Robeson gave him a hard look. "This must be what happened to the *Atlantis*."

"Yes, Mr. President." He kept his voice flat. "They appear determined to keep us from making gamma-ray observations."

"I have my own observation to make," said the president. "There's a term for the situation where others attack your national assets, where they kill your citizens.

"We call it a state of war."

It would be a strange war, a conflict unlike any Earth had ever known.

The Galactics had yet to reveal a credible motive for their hostility. Like so much of what the humans *thought* they had learned about the F'thk, the aliens' behind-the-scenes hints were contradictory and apparently part of their inscrutable plot. Ambassador H'ffl had also confidentially told the Russians of the authoritarian and individualist factions among the Galactics—but in this version, the F'thk were socialists in the authoritarians' camp, worried about an anarchist mole in their midst.

The war against the aliens must also remain hidden, for no one could fathom why, if the Galactics wanted to destroy humanity, they did not simply *do* it. The gigantic mothership orbiting the moon, regally indifferent to any direct communication from Earth, was never far from anyone's mind. Perhaps nothing but rationalization or a sense of squeamishness separated Earth from direct annihilation by the aliens—reticence that could give way to resolve if the humans were not seen to be playing their assigned roles. Earth would fight its war for survival as its antagonists had inexplicably begun it: through subterfuge.

And so the F'thk, and the vast majority of the people of Earth, would be encouraged to believe that great and foolish powers were edging ever closer to the nuclear brink . . . while the few human leaders and scientists in the know were riddled with doubts. How dangerously easy it would be for the *appearance* of imminent global warfare being so realistically maintained to become cataclysmic reality.

Unless and until that catastrophe occurred, Earth's best minds would—when their disappearance from Galactic orbs and compromised global communications could be justified—work to unravel the mysteries and to imagine any possible defense against the Galactic powers already revealed.

Silver light angled through the leafy canopy. As three men reached a small clearing, one paused. He glanced overhead to the full moon, his lips moving silently.

"What's that, Kyle?"

"A bit of poetry, Mr. President." He jammed his hands into his pockets. "I've always known that somehow, some day, I'd go to the moon. It's what drew me to physics in the first place. The day I met Sergei, moments before the *Atlantis* disaster, I told him I was sure that man would return there. The key to all this is the Galactics' mothership—out there, circling the moon. If we're to succeed, *we* must go there."

"So what's the poetry?" asked the president.

Kyle tipped his head back, the better to observe the world that had for so long held his fascination. Feeling strangely like an oracle, he spoke crisply the

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words he had earlier been moved to whisper. "I'll come to thee by moonlight, though hell should bar the way."

" 'The Highwayman'? Unless you're an incurable romantic, that poem doesn't exactly have a happy ending."

Kyle's eyes did not leave the beckoning moon. "I'm an incurable *realist*. I'll do what I must, go where I must, to achieve a happy ending.

"And that's where I think it will be."

CHAPTER 8

"A generally unrecognized contributor to the worldview of the Krulirim," dictated Swelk, "is the symmetry of the Krul body shape." Outside her cabin a raucous comment, followed by bellows of laughter, defeated the computer's attempt to parse her words. She repeated the sentence. Immersion in her longtime studies was a distraction from brooding about the work she *should* have been doing—and from which she was so inexplicably barred.

Her latched door quivered from the impact of something heavy—or rather, some*one*, because he spoke. The complaint was drunken, slurred and indistinct, but the word "freak" was clear enough.

"The Krul body is commonly described as triform, as most of its components occur in threes. Within the largely spherical central mass, internal organs are triplicated. Three limbs, spaced equidistantly around the torso, are equally adapted for locomotion and manipulation. Each limb ends in a three-part extremity, which in turn bears three digits. Limbs, extremities, and digits are all opposable, providing three progressively finer levels of physical control. Sensory stalks near the top of the central mass are also triplicated, providing multi-perspective audio and video imagery at all points in a full circle around the Krul.

"Despite the understandable descriptive focus on triplication, the effective symmetry of the Krul form, which favors no specific direction, is radial. So complete is this effective radial symmetry that a Krul observer does not and cannot locate a physical object solely by reference to her body. Distance from the observer may be so defined, but the second geometric parameter needed to localize an object within a plane requires a reference external to the body. The magnetic sense of the Krul provides this external reference, by defining a line between her and the nearest magnetic pole. An angle with respect to this line of external reference can then be combined with the body-centric radial distance. . . ."

Non-reaction sometimes discouraged those outside. Not this time. Impacts continued to rattle her door, and yelling to scramble her dictation. The frequency of the interruptions showed it was once more open season on misfits. How would those outside react, Swelk wondered, if told their successful adaptation to life on a spaceship showed *they* were freaks? Most Krulirim could not function outside a planetary-scaled magnetic field—the inconstancy of the shipboard artificial field, its orientation noticeably changing with every few steps taken, induced nausea and confusion.

Not well at all, she decided. She checkpointed the computer and tucked it into a pocket. Any work she got done today would have to be accomplished someplace more secluded. The same was likely true of any sleep she might hope for. Taking a deep breath, she flung open the door to run the gauntlet to somewhere hopefully quieter.

"Swelkie, you monstrosity. Weirdo. Abomination." Taking tones of voice into account, the taunts ranged from condescending affection, as one might address an ugly but familiar pet, to open hostility. The captain presumably intended no permanent harm to befall Swelk—she remained an occasional resource to the project from which she was so aggravatingly excluded, not to mention a paying passenger—but the crew, to whom her quasi-confinement had been

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entrusted, did not necessarily understand the intended limits to their abuse. The scientist within her recognized with cool detachment that they might lack the self-restraint to overcome ages of social conditioning and temper their mistreatments.

"Hello, Froll. How's it going, Brelf?" She was unable to extend all her placative greetings before the harassment began. It's not personal, it's not personal, she told herself silently. She dodged a flung partially eaten piece of fruit, only to trip over something thrust between her limbs. A delighted roar greeted the *splat* of her graceless landing, followed by gales of laughter as Brelf, ever the ringleader, dumped on her a cup of something pungent. The cackling intensified as Swelk slipped in a pool of the liquid while trying to stand up.

"So where are you going, beautiful?" Brelf's witticism set them all off to tittering.

"To clean up, I think." Her uncomplaining acceptance of their pranks seemed to satisfy them; they did nothing more as she struggled, with more care this time, to an erect position. They let her pass, content to guffaw at her clumsy progress down the corridor, her lame limb trembling, before returning to whatever drunken game of chance the sorry fact of her existence had so unjustly distracted them from.

Her lame limb trembling. My curse in a phrase, thought Swelk, limping to a quieter part of the ship. And if my disability weren't enough, they blame me for adding perhaps two three-cubes of years to this voyage. That reckoning was in Krulchuk years, of course, not ship's time, but whether a starfarer ever saw family and friends again depended on the passage of time on the home world. Most people did not leave home.

"Swelk!"

She pulled herself to full height, bearing most of her weight on the good limbs, aware that she still dripped soup. "Yes, Captain."

"My officers and I are too busy to deal right now with passengers. Why are you out of your quarters?"

Translation: too busy to deal with her. The shreds of wet vegetable sticking to her body were suddenly an asset. "A mishap, sir. I came forward for cleaning supplies from ship's stores."

"Very well." Captain Grelben leaned slightly. Balanced effortlessly on two limbs, he pointed down the hall with the third. "Find your supplies, get cleaned up, and return to your cabin." Dropping to all threes, he strode away. He disappeared into the officers lounge, through whose briefly open door could be seen not only several officers but also the ship's other passengers. They were using the translation and cultural interpretation program she had trained, the expert-system software whose operations she had been too naively trusting to keep to herself.

In the blissful quiet of the storeroom, Swelk surrendered to anger and fear. Her body shook; her weak limb threatened to collapse of its own accord. She lowered herself, wearily, to the deck. The hard lump in her pocket reminded her that she'd come here to continue on her treatise, but she was no longer in the mood. It was *not* supposed to be this way.

It was not fair. It was not right. But when had Swelk's life ever been either?

CHAPTER 9

Krul came in only two kinds: perfect and mutants.

The race had had to advance from cave dwellers to a society rooted in science before radioactivity, the cause of most mutation, was discovered. They had had to develop interstellar travel to learn that the concentrations of radioactive elements in Krulchuk's core and crust were unusually high. By the time they knew enough to say, "There but for the aim of an alpha particle go I," by the time medical advancements would have

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permitted prenatal correction of most mutations, selective infanticide had long been an unquestioned cultural imperative. Swelk was even sympathetic in the abstract to the custom, without which the Krulirim would never have cohered long enough as a species to *have* technology.

So abnormal newborns continued to be put out of their parents' misery. Swelk was doubly a freak, because, despite her flaws, she still lived. Swelk's father had been too resentful of Swelk's mother's death in childbirth to relinquish a living entity to blame. Once Father had sufficiently recovered from his loss to do the right thing, too much time had passed—the "civilized" fiction that Swelk had succumbed naturally to her birth defects was no longer credible.

Swelk seldom saw her father. Her nurse taught that when life gives you a kwelth, you make kwelthor stew with it. Swelk didn't care for stew, kwelthor or other, but she took the point.

So, she was a freak in an intensely conformist society, and nothing she could do would change that. Swelk picked her type of "stew": to be the objective outside observer of a society that lacked outsiders.

Over time, Swelk's personal journal overflowed with commentary about the society that, from her unique perspective, was closed and intolerant. Her restlessness grew with the volume of her private notes. Krulchuk became too confining: unwilling to offer her an opportunity, increasingly devoid of any even mildly interesting variety.

The more Krulchuk palled, the more the stars beckoned to her: new worlds, different societies, other intelligent species. Father gladly paid her fare—with luck the frontier or the rigors of travel would kill her off, or he himself might have passed on before the monstrosity's return. In the worst case, Swelk's return during Father's lifetime, her tour of Krulchukor colonies would still have spared him the embarrassment of her freakish presence for some three-cubes of years.

She realized after the first few planetfalls what only wishful thinking had kept her from extrapolating before leaving home. Krulirim brook *no* deviancy; ergo, transplanted communities differed little from the society of the ancestral world. If anything, the new societies were more orthodox, less accepting of differences, than the home world. On any worlds with the potential to support Krulchukor life, exotic biospheres were systematically weakened to make way for imported biota. Those sentients that had been discovered, none nearly so advanced as her own species, were quarantined and systematically looted of any worthwhile resources. Disdain and neglect combined in an unofficial policy of cultural destruction.

She cashed in her remaining tickets to buy passage on the first starship returning to Krulchuk. That vessel was the *Consensus*, a well-used cargo craft with a few cabins for passengers of limited means and corresponding expectations.

She knew no one aboard the *Consensus*, but that hardly mattered. Her nurse aside, and she had passed on, the Krulirim of Swelk's acquaintance mistreated her no less than did strangers. Few Krul ever encountered anyone as visually different as she; those exceptions lacked precedents for how to behave towards her. Deference to authority generally won out—her treatment generally depended on how authority figures treated her. Shipboard, the captain's impatience with and sometime ridicule of her were quickly adopted.

She gladly stayed in her room at first, organizing the extensive if disappointing notes from her travels. When her tiny cabin grew tiresome, she volunteered, notwithstanding her status as a passenger, to stand watches. Between stars, nothing ever happened on a watch, but someone was required on the bridge just in case. She expected no gratitude from officers spared the boring duty, nor did

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she receive any—she was content with a change of scenery and less confining surroundings in which to be shunned. And for the comparative peace . . . Captain Grelben did not tolerate harassment when Swelk was on watch.

And that was why Swelk was the one to detect the radio signals from Earth.

The unexpected signals were at first faint and erratic, and Swelk did not doubt that any of Captain Grelben's undisciplined staff would have simply ignored them. She persevered. Coping with her handicap, and with those who would torment her because of it, had taught her patience.

The radio-frequency anomalies had progressed slowly from arguably a figment of her imagination to formless certainty—the *Consensus* was not traveling towards the unexplained broadcasts; rather the signals themselves kept getting stronger. Taking on more and more extra shifts, she had slowly learned to assign various patterns to different languages. Her puzzled analyses grew more focused, if still unproductive.

She had yelped in surprise upon determining the modulation scheme that converted some of the radio waves streaming past the *Consensus* into moving pictures. A bit more tweaking had added a synchronized sound subchannel to the moving pictures. Now she began to adopt the software she had trained across visits to several worlds to learning and translating the unknowns' communications.

Even as Captain Grelben acknowledged Swelk's progress, the discovery brought renewed cruelty from the crew. "Trust the freak to find more freaks." And these beings *were* odd by Krul standards, with separate limb-types in pairs: a bottom set dedicated to locomotion and a top set to manipulation. Their bodies moved preferentially in one direction, like Swelk's; their sense organs favored that side. By reason of her handicap and the shunning of her own kind, Swelk sometimes felt closer to the humans than to her shipmates.

And then, amid the ever-swelling torrent of signals, Swelk encountered what must have been educational material for the youngest of the aliens. It was elemental: basic symbols and acting out of their meanings, fundamental concepts repeated in endless variations. While the big bird never made sense to her, she came to recognize numbers, the sounds that went with letters, whole words. Her vocabulary grew. In time, other Earth television programs made sense.

And the more she learned, the deeper became her sense of wonder.

Swelk's discovery had for a time transformed the trip from mundane disappointment to the wondrous adventure of which she had dreamed.

She was not the only passenger on the *Consensus*, although she did not know much about the others. Their cabins were in the better-tended parts of the ship, while she had been exiled to what she suspected was a former closet in the crew quarters. The other passengers were somehow involved in the entertainment industry, she gathered. Popular amusement had no appeal to Swelk, the unvarying perfection of the actors just one more personal rebuke.

She was astonished when Rualf, the leader of the other passengers, took Swelk's part in an argument with the captain.

Swelk had become forceful for only the second time in her life. The first time had been to negotiate the terms of what she and her father both saw, for quite different reasons, as a voyage of liberation. This time she was arguing with Captain Grelben to divert the *Consensus* to investigate Earth.

Pre-spaceflight philosophers on Krulchuk had accepted without qualm or question the silence of the cosmos. Surely the Krulirim, who alone had overcome the universal tendency of species to mutate into oblivion, were

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the ideal and only intelligent race. Starflight had necessitated a redefinition of that uniqueness: the planets of many stars fostered life, and intelligence, or at least the use of language and tools, arose almost as often. Krulchukor superiority and—of course—centrality survived those discoveries, because the Krulirim remained in one way unique: their mastery of technology. When other intelligences obtained technology, it mastered them. Two three-squares of worlds were known where the dominant species once aspired to technical greatness and the stars; they had achieved only self-destruction and ruin. The causes varied—overbreeding, environmental devastation, genetic-engineering disasters, and, most frequently, nuclear immolation—but the effects, collapse and regression, were constants. And so the superiority of the Krulirim, and the perfection of everything about them, was vindicated. . . .

One more supposedly intelligent species, argued the captain, meant nothing. It was of little interest, and even less cause for diverting the *Consensus*. These humans would only destroy themselves, while *he* incurred huge penalties for late deliveries, and his debts continued to pile up. Relativity slowed many things, but not the accumulation of interest.

"But they are right at the crisis point," Swelk argued, "perhaps *past* the crisis, if only barely. They speak of reducing their nuclear weapons, remedying their ecological excesses. If I am right, the Krulirim could have a companion advanced species."

Grelben, unlike his suddenly assertive passenger, equally monitored all directions at once. Nothing in his stance indicated that he was seeing the recovered television pictures from Earth, appearing on several screens on the bridge. Swelk nonetheless knew he *was*; the shiver in the spacer's body declared that what Swelk suggested was anathema. One deformed adult Krul on board was almost too much to bear—could any sane person consider normal a technologically capable planet that teemed with such deviancy? "We will *not* change our course, you. . . ."

"Captain Grelben, if I may." Rualf glided onto the bridge with a grace Swelk could only envy. His entrance had surely spared the cripple a devastating insult.

"Of course, sir." The quick transition to deference was astonishing.

"Captain, I've overheard in the corridors a little about this curious discovery." Rualf's sensor stalks wiggled in an understated display of worldly amusement. "Would it be possible to hear a bit about it directly?"

"You heard the man," snarled the captain.

Swelk needed no encouragement: here, finally, was someone interested in her amazing find. Rualf and his company were widely traveled; perhaps she had lost faith too soon. Perhaps somewhere among the worlds of the Krulirim there *were* people with the creativity and imagination to consider new ideas. Maybe even people to whom Swelk could sometime explain her concepts of group dynamics and social organization.

She launched into an ardent exposition on the challenges of technological development, the crises certain technologies caused societies, the failure of Krulchukor explorers to find any peer-level species. She waxed eloquent that this new species, whose presence had become clear from its radio broadcasts, could yet survive this crisis and become equals. Krulchukor philosophers had long postulated that a self-destructive drive was inherent in all other races; she marveled at the rebirth in thinking and worldview that would arise once such Krul-centered thinking was disproven.

Swelk was too enthusiastic, too rapt in futuristic visions, to take notice of the subtle interactions of gesture and posture between captain and honored passenger. All that registered of her audience's reaction—an audience! what an

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unaccustomed concept!—was Rualf's spoken response.

"Young woman, you have discovered something extraordinary. I find myself intrigued. Perhaps you will allow me to discuss the matter in private with our captain."

Giddy with the unexpected courtesy, even praise, Swelk stammered her concurrence and limped from the bridge.

Rualf had had influence that Swelk could only envy. The *Consensus* was redirected, with the full support of all passengers, to investigate Earth.

CHAPTER 10

Captain Grelben became harsh in enforcing Swelk's detention once the *Consensus* neared the humans' solar system. Detention was her term, not his; he merely made clear that she was unwelcome without invitation beyond the crew quarters. Rualf's coterie made similar feelings plain. Officers and passengers alike fell silent whenever she approached—and there was no possibility of sneaking up on beings who sensed equally well in all directions.

A life spent as an outside observer then served her well. She gleaned what she could from overheard bits of conversation, from changes to shipboard routine, from the general announcements that preceded and accompanied the ship's maneuvers. She knew, though no one told her directly, that the *Consensus* had stopped at Earth's moon, that still mysterious preparations had been made there, that direct radio contact had been established with—in the crew's words—Swelk's freaks.

Rualf occasionally solicited her help in the translation or interpretation of a radio intercept while sharing as little information as possible: her "independent" commentary, he said, was invaluable. Rualf was always scrupulously polite; Swelk realized too late that the open-mindedness she had trusted was a sham, an example of his art. She remained clueless as to his interest in the discovery of the humans, *so* interested that he'd championed rerouting the flight he had chartered.

So, from many sources and with much deduction, she learned that her hopes had been realized. The humans had *not* let their technology destroy them!

Now, as the ship hopped from one Earth location to the next, the crew was content to stay aboard. Experiencing an alien culture had no attraction to normal Krulirim, nor was Earth itself hospitable: its sunlight was too hot and yellow, its thin ozone layer admitted unsafe levels of UV, its carbon-dioxide level was non-lethal but debilitating. Onboard at a landing strip or onboard in a parking orbit—it was all the same to the able-bodied spacers. Her own requests to visit with the humans were rejected.

Something happened at those landings, though, something to which only the officers and *normal* passengers were privy. Rualf alone among the inner circle occasionally shared crumbs of news about the humans. The more robust *her* translation program grew from extended use, the more Rualf's sporadic comments tilted towards smug superiority about progress in some undisclosed grand scheme.

Swelk burnt with curiosity, outrage, and feelings of injustice. Before each planetfall she was escorted to her cabin, "So as not to be in the way, you understand."

Fuming in her tiny room yet again, she reached a decision. She opened her door. "Brelf," she shouted. "I have an offer for you."

The deckhand was off duty, which meant he'd be drinking or gambling. Probably both. Hearing his off-color stage whisper to his shiftmates, and their titters, she allowed herself a moment of satisfaction: she'd picked her words to encourage some amusement at her own expense. Brelf emerged from the crew galley looking satisfied with his cleverness, his buddies following. "What do

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you want, Swelkie?"

"Out of here, of course." To their laughter she added, "Any more time in this closet will drive me insane." She dipped her sensor stalks in a pout. "Trust me, that wouldn't be a pretty sight."

They roared in appreciation, the freak poking fun at herself.

"So here's my idea. I'm so tired of talking to myself that even a Girillian swampbeast would be enjoyable company."

Brelf flexed the digits of an extremity thoughtfully. "Well, Swelkie, that is an interesting suggestion. I'm sure you know that we have a couple of swampbeasts on board. Not just them; we have ourselves a whole Girillian menagerie, and a messy, ill-tempered bunch they are. Thanks to you and your humans, we'll be watching over the monsters for a whole lot longer before they get to the imperial zoo on Krulchuk." He tipped onto twos, sweeping the unburdened limb inclusively across the group of his mates. "Anyone here care to let Swelkie take their shift feeding the beasties?"

"And cleaning up their shit afterwards!" someone added, evoking more hilarity.

"What do you say, Swelkie? Are you so tired of your deluxe accommodations that you would do a little light cleaning for us?"

Success! Willing her voice calm, she flexed her shortened limb. "I guess I can use the exercise."

"Come along then, Swelkie," said Brelf. "Who knows? A swampbeast may find even you attractive."

Swampbeasts turned out not to be the most stimulating companions Swelk had ever had, but neither were they the worst. Where Swelk's sidedness resulted from a congenitally deformed limb and the need to cope with it, swampbeasts were naturally bilateral in two different respects. There were three limbs on each side, each limb flaring into a large webbed appendage that distributed their weight over a broad area to keep them from sinking into their native muck. The eating end had a protuberance that held not only the mouth, but also the brain and many of the creature's sensory elements. The animals ate more or less constantly, and excreted almost as rapidly out the other end, an apparent trick to keep them well stocked with nutrients while minimizing the body weight to be suspended above the swamp.

She raked together their many droppings without complaint. The animals wouldn't care about her disapproval, and anyway, she had asked to be here. Every so often she would trade her rake for a shovel, emptying the dung into a standard bioconverter. The machine recycled the wastes, plus a dollop of fresh chemicals from ship's stores, into fodder as wholesome as could be found in any swamp on Girillia.

That was the theory, anyway. With Swelk's surreptitious adjustment to the bioconverter, the food was not quite that wholesome. She felt some minor guilt about her actions, the swampbeasts being aggrieved first in their capture, then in the mud-free artificiality of their confinement, and now in her treatment of them. Guilt or no, the feed they now received failed to agree with them. The cargo hold pressed into service as a zoo was awash with feces, fouler smelling even than usual. None of the crew objected to her taking as many caretaker shifts as she wished. Brelf and his pals found the outbreak of diarrhea hilarious. "Seeing Swelk makes even a swampbeast ill."

The stench served a purpose: it substituted for close supervision when she was out of her cabin. No one wanted to be near her while she took care of the menagerie. That, in the end, was her purpose. The *Consensus* carried four lifeboats, one of which was reached through the cargo hold that had become the Girillian zoo. The access hatches that led to the lifeboats were all monitored

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by sensors that reported to the bridge—but one cut wire guaranteed that the sensor to this lifeboat always reported the hatch to be shut.

She had unencumbered access to the tiny but complete spacecraft. One part of the lifeboat's equipment was a radio.

CHAPTER 11

Her first uncensored news made Swelk wonder if she had gone mad.

The broadcasts she had monitored most of the way to Earth had shown humanity resolving old grievances, de-alerting its missiles, reducing its weapons of mass destruction. Stepping away from the nuclear brink. . . .

Since she'd been excluded from the broadcasts, which had not been a long time, much of that progress had been reversed. The latest reports made clear that tensions had ratcheted up again. The airwaves were full of threats and dangerous bravado.

An even bigger shock was the *other* story that dominated the human media: the visit of the Galactics. Other starfarers had arrived at about the same time as the *Consensus*. Earth was being appraised for membership in some interstellar commonwealth. Earth's evaluators were welcomed everywhere, lured by the promise of the Galactics' fusion technology to those nations that cooperated.

The Krulirim had had interstellar travel for generations, without encountering a people as capable as themselves—not even, until now, anyone as advanced as the humans. Some intelligent species had failed to exit the Stone Age. Those that had achieved higher technology universally reversed course, living pathetically amid the mysterious and often deadly ruins of their own former greatness.

The Galactic species touring and inspecting Earth bore no resemblance to any intelligent race known to Krulchukor science. A recognizable offshoot of an otherwise self-destructive race would have made some sense, would have been satisfying to her. That wasn't the case—the F'thk were totally unknown. If she couldn't account for this one species, what explanation could there be for the appearance of a whole multi-species federation?

And while the F'thk were all over the humans' news, she saw not one Krul.

How could it be that she'd overheard nothing, from anyone on the *Consensus*, of the supposed impossible: starfarers of a species other than their own?

In her confusion, she almost forgot to reemerge from the lifeboat to continue her zookeeper duties. The trilling alarm of her pocket clock saved her. She would surely have died of disappointment and curiosity if, deception discovered, she again lost touch with events on Earth. She programmed the lifeboat's computer to record selected topics and sources for her, then reluctantly returned to the cargo hold.

With renewed feelings of guilt, Swelk arranged for the unexplained ailment to spread to two other Girillian species. She needed lots of time unsupervised.

"Captain." Swelk tipped her torso towards Grelben respectfully, carefully keeping her bad limb behind her, out of his line of sight. Stretching the shortened limb this way was painful, but normals took hiding of her infirmity as a sign of respect.

Experimentation had shown that he was least antagonistic when they were away from the humans. They were in Earth orbit now. "May I have a moment of your time, sir?"

His olfactory organs wrinkled. "Make it quick. You stink of those foul creatures in the hold."

"My apologies, sir." The bastard: having paid for her passage, she was doing the work his crew found too objectionable. That was unimportant and by her own design; she tamped down the irrelevant thought, unexpressed. "I wondered about your contacts with the humans. Was I right? Does it look like they

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will succeed?"

"It does not seem so. In fact, they are moving quickly towards blowing themselves up." He flexed an extremity. The expression was thoughtful, yes, but also implied something else. Anticipation? "At least this bunch will be remembered better than most. We'll have records of what they accomplished and how it ended."

There was a time when Swelk would have accepted Grelben's statements without question. Growing up a freak, her defects a cause for comment by every passerby, she often hid herself away. Still, as unskilled as were her interpersonal skills, his comments failed to ring true.

"So we will do more than save copies of their own broadcasts?" The two eyes turned toward her narrowed in momentary suspicion, then relaxed. Though Grelben's inability to see Swelk as an equal served her purposes, she fumed inwardly. Underestimating the freak was a too-common reaction.

"Rualf's troupe is making additional recordings with their own equipment. We may also be able to save some human artifacts."

"Then I guess we're doing everything we can." His eyes narrowed briefly again before once more rejecting the possible double meaning.

That her words could have a double meaning—despite not knowing what that second denotation could be—was a chilling confirmation of her darkest fears.

The hastily programmed data filter had worked well: Swelk's next visit to the lifeboat was rewarded with an eye-popping collection of television intercepts.

The presence of the Galactics changed the bigger picture. It would be tragic if the humans, so close to achieving maturity, self-destructed, but her bigger dream was intact. The Galactics, wherever they came from, had obviously attained social maturity. Here was companionship for the Krulirim. Here were alternative body forms, and intelligences who would have no reason to disparage what to them would surely be Swelk's very minor differences.

More than anything, she ached to visit the Galactic mothership. The human media seemed every bit as fascinated with it as she; telescopic views of the habitat-sized vessel were backdrop to many news broadcasts. The lifeboat's computer did the conversion from human units of measurement: the spacecraft waiting in orbit around Earth's moon was enormous, as large as Krulchuk's own third-largest moon. The object's perfectly burnished surface, bristling with countless antennae and hatches, made plain that this was an artificial structure.

The human media seemed never to tire of covering F'thk visits to Earth's cities. Those visits, she first thought, came in approximate order of political importance. Coverage of Earth's other major story, the slide towards nuclear war, corrected her impression. The F'thk ship was frequenting, in approximate order of destructive capability, the capitals of Earth's declared and suspected nuclear powers.

An insistent alarm recalled her again to her duties at slopping the animals and hosing down feces-covered decks. "Just one more video," she promised herself, resetting the timepiece to extend her stay briefly. It was a good decision: the next item in the queue was coverage of the initial F'thk visit to a city called Baghdad.

Unlike the galactic mothership, the F'thk landing ship was of a scale with which Swelk could identify. Using individuals in the welcoming crowd for scale, she decided that the F'thk vessel was somewhat smaller than the interstellar passenger ship on which she had begun her grand tour. That vessel, the *Unity*, was her standard of reference; shuttle-crew hostility had kept her in her

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cabin on approach to the in-orbit, about-to-depart *Consensus*.

The F'thk gave speeches. Dark-skinned humans with facial hair gave speeches. A nondescript hovercraft deployed from the ship to deliver a kiosk of some sort to an Iraqi park. The F'thk spokesperson operated the machine, extracting and distributing ceremonial objects of some sort. She fast-forwarded: long after the dignitaries left, masses of people queued up for the souvenirs.

Her alarm chimed again, and this time she dared not wait. She closed the lifeboat behind her and returned to the unaccustomed physical labor that made so much possible for her.

Though the knowledge had been slow in coming, Swelk had learned to recognize Rualf's correct manners as a manifestation of his art and a disguise for his contempt. Now Swelk would test her own skills of deception. The next time the actor summoned her to discuss a bit of intercepted video, Swelk was sensitized for any evidence or clues, no matter how veiled.

She tipped her sensor stalks one way after another, as if the flat image would reveal new information from the various perspectives. Play the fool. "I recognize the human behind the desk. He is often in the material you show me. Who is he?"

"The leader of their most powerful subdivision. He is called the president."

"And these others?"

"Advisors of the president. Now listen." Rualf repeated the video.

She listened carefully to the recording, then asked for a replay. "This subdivision, this country, feels threatened by another called Russia. Those sound like alternative nuclear-warfare strategies under review."

"Certainly," said Rualf, his tone indicating impatience. Belaboring the obvious was not why he deigned to deal with her. And if nuclear-strike planning was underway, then the horrible crisis that Swelk dreaded could be almost upon the humans.

"My question, Rualf, is this: why would they broadcast such stuff? Detailed planning for an all-out war is surely meant to be secret."

"This is not from a broadcast," Rualf conceded.

"I am astonished they would discuss these matters in front of visiting Krulirim, or allow you to record them."

Rualf was silent for a long time; Swelk wondered if her probing had been too overt. Boastfulness eventually defeated caution. "These are not matters they would care to discuss in front of outsiders." He whistled sharply in amusement. "Did you hear what I said? In *front*. I've been dealing with these absurd creatures for too long.

"Never mind that, you *are* right—and since you recognized this isn't a human video, I may as well make it easier to view." He adjusted a control, changing the presentation to 3-D, then rewound towards the midpoint of the recording. "Here. See that crystalline sphere in a bowl on a metallic base on the president's desk? We give those spheres out as gifts all over Earth, especially to the decision makers. The images we are watching are from another such globe elsewhere in his office.

"It's a passive audiovisual recording device. Periodically we scan their major cities with steerable microwave beams. The microwaves provide momentary power to the devices to upload whatever they've recorded."

Rualf misunderstood her dumbfounded look. "I'm not surprised that you never encountered these gadgets. We use them all the time in making 3-V films, but moviemaking is the only way I've ever seen them used."

She *had* seen such objects, however. The surreptitious Krulchukor bugging device was one of the souvenirs manufactured by the Galactic friendship stations and distributed by the F'thk. □

To be continued!

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SCIENCE FACT

You Can Change Your Genes

Catherine H. Shaffer

The Transforming Principle

We owe our understanding of human genetics to a nineteenth century monk who liked to putter around in his garden. Gregor Mendel was the first scientist to observe the laws of genetic inheritance. Using pea plants, he mapped the ways in which round and wrinkled seeds were passed down through generations.

Other biologists built on Mendel's foundation, but it wasn't until 1944 that deoxyribonucleic acid (DNA) was discovered as the carrier of genetic information. Later, in 1953, James Watson and Francis Crick solved the three-dimensional structure of DNA. Scientists now knew that genes existed in the form of long, double-helical strands of DNA, bunched into chromosomes in the nucleus of a cell, and were passed down through mendelian inheritance.

Each nucleic acid triplet of a DNA chain encodes a single amino acid. For example, adenine-guanine-adenine (AGA) encodes the amino acid arginine. Ribosomes string these amino acids together to make proteins. Some proteins are structural, like the collagen in your fingernails or the myosin of your muscle fibers. Others catalyze chemical reactions in the body: everything from digesting the food you eat to converting oxygen into usable energy.

Occasionally there's a mistake. If a mistake occurs in a gene, it affects the protein encoded by that gene. In the example above, AGA encodes arginine. Changing a single nucleic acid, G to A, gives you AAA, the code for lysine. In many cases, such a *point mutation*, changing arginine to lysine, makes no difference. But occasionally it can change the function of the protein. Genetic diseases are caused by such changes. The NIH office of rare diseases serves twenty-five million Americans suffering from over six thousand diseases, most of them genetic in nature.

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NCBI Genbank (a service of the National Institutes of Health) maintains an online searchable database of human genes and genetic disorders with more than thirteen thousand entries mapping to more than eleven hundred identified phenotypes (the outward physical manifestation of a gene). Identifying the gene that causes an illness is the first step towards curing it.

Knowing what causes the disease is one thing, but changing the defect in all of the body's 5×10^{13} cells (or even a significant subset) is quite another. Science took its first steps toward functional gene therapy in the 1970s, with the discovery that Moloney leukemia virus could integrate into the mouse genome and be passed to offspring as a dominant gene through normal, mendelian inheritance.

Taking inspiration from these experiments, Dr. Franklin Costantini and his research team in Oxford, England injected a rabbit gene into a fertilized mouse egg, and followed the transmission of the gene into the mouse germ line, creating a stable line of mice which carried the rabbit gene, ushering in a new era of animal *transgenics*. Through the 1980s, animal gene shuffling experiments laid the groundwork for human gene-therapy research. The rules of scientific ethics prevented researchers from injecting new genes into human embryos, but they began looking for other ways to introduce genes into the human body.

Ashanthi DeSilva

In September, 1990, Dr. W. French Anderson of the NIH performed a revolutionary experiment. He gave 4-year-old Ashanthi DeSilva a new gene for adenosine deaminase (ADA) to fill in for her faulty one. Ashanthi suffered from ADA-dependent severe combined immune deficiency (SCID). SCID sufferers often spend their lives in protective isolation because of a non-functional immune system, as "bubble babies." Over a six-month period, the gene-corrected T lymphocytes multiplied in Ashanthi's body, increasing to 25% of normal levels.

This early success stimulated a great deal of interest and enthusiasm for gene therapy. Over the next ten years, as Ashanthi grew into a healthy teenager, the FDA approved hundreds of new gene-therapy trials. Unfortunately, the field languished as researchers struggled with the complex realities of their elegant experiments. Ashanthi DeSilva's cure, viewed at first as the harbinger of a new era in medicine, dwindled in importance.

In a 1998 review in *Science*, Dr. Anderson wrote, "Except for anecdotal reports of individual patients being helped, there is still no conclusive evidence that a gene therapy product has been successful in the treatment of human disease." More bluntly, Abbey S. Meyers, president of the National Organization for Rare Disorders, Inc., said, "We haven't even taken one baby step beyond that first clinical experiment."

Vectors

The delivery device in a gene-therapy experiment is called the *vector*. Sixty percent of all clinical trials in gene therapy have used retroviral vectors, as in Dr. Anderson's early SCID experiment. The retrovirus is an ingenious DNA-transfer device designed by Mother Nature. Gene delivery is efficient, predictable, and stable. However, gene expression from a retroviral vector can be erratic and difficult to control. Also, because a retroviral vector integrates into the host's genome, and because that integration is random, there is a small chance that vector could dump its load into a cancer-causing gene. In fact, during a German gene-therapy experiment reported in 2002, ten mice developed leukemia after receiving the same kind of modified-bone-marrow treatment given to SCID patients. Later investigation revealed that the retrovirus had activated a gene that causes leukemia. The

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odds of this event occurring, previously estimated at one in ten million, may have to be revised.

The next most popular gene-therapy vector is adenovirus, which causes the common cold. When adenovirus infects a cell, it doesn't integrate into the cell's nuclear DNA, but remains separate, in the form of an *episome*. Thus, there's no risk of cancer resulting from random integration.

Researchers originally modified the cold virus by stripping out most of the viral proteins, leaving room for large gene inserts. However, one of the regions removed, called E3, encodes a protein that protects the virus from immune surveillance. Lacking this genetic cloaking device, the adenoviral vector stimulates powerful immune responses, a side effect that would give gene therapists one of their harshest lessons. (More on this later.)

Other viruses enlisted in the battle against human hereditary disease include adenoassociated viruses, herpes virus, HIV, and vaccinia, each with its own peculiar advantages, and its own complications and dangers, which have led researchers to investigate non-viral methods of DNA delivery in gene therapy. Some alternate solutions include encasing the DNA in cationic lipids, liposomes, or even injecting it naked.

Surprisingly, researchers have had promising early results injecting naked DNA into tissues such as liver and muscle, particularly cardiac muscle, which can be stimulated to grow new arteries—a potential alternative to bypass surgery.

Then there are methods just slightly more . . . forceful.

John Sanford may be the rootinest, tootinest genetic researcher either side of the Mississippi. In 1983, while human geneticists were tricking cells into taking up DNA, Sanford was blasting it in with a .22-caliber air rifle. The cell walls of plants form a rigid, nearly impenetrable barrier. With the help of two engineers at Cornell's Nanofabrication Facility, he invented a device that shoots microscopic particles of tungsten coated with DNA. The gun, fit with a metal barrier at the end of the barrel, fires a plastic bullet. The barrier is coated on the outside with tungsten/DNA particles. The impact sends the tungsten particles flying—right through the plant's cell walls, carrying the DNA along for the ride. Sanford's invention, now marketed by DuPont, is known as a "gene gun." Many types of gene guns have been developed. Some are powered by compressed air, some use an ammunition-like cartridge with gunpowder. Some models use a disk rather than a bullet for a projectile, or gold instead of tungsten for the carrier beads. The agriculture industry has used the gene gun to develop many of our common strains of wheat and soybeans.

Human geneticists have only recently discovered the gene gun. Frustrated by fussy viral vectors that don't work and sometimes kill their hosts, researchers in the dermatology branch of the National Cancer Institute have locked and loaded, and are now firing DNA-coated gold beads into skin cancers. The method offers a way around the drawbacks and dangers of viral gene therapy, as long as you don't mind the drawbacks and dangers of live gunpowder.

Jesse Gelsinger

By 1999, hundreds of publications, meetings, and reviews had amounted to exactly zero FDA-approved gene therapies. And yet, the field would experience an abrupt coming-of-age with the death of eighteen-year-old Jesse Gelsinger.

Gelsinger suffered from ornithine transaminase deficiency, an inherited disorder which disrupts the metabolism of nitrogen compounds. He controlled his illness, which manifested in a particularly mild form, through a low-protein diet and medication. He was eager, however, to enroll in a new clinical trial at

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the University of Pennsylvania which offered the hope of a permanent cure and an end to the tiresome diet and medication regimen. He died within days of receiving a dose of gene-modified, adenoviral vector. Subsequent investigations determined that Gelsinger's immune system reacted violently to the virus, sending his body into multiple-organ failure, a known risk with adenovirus.

Although the death of a young person is always a tragedy, this event struck the scientific community like a lightning bolt. In scientific parlance, what Jesse Gelsinger experienced was a *serious adverse event* or SAE. Each year, an average of eight hundred SAEs are reported to the FDA. One out of thirty study subjects will have an SAE and an average of 3.6 deaths occur each year. Not all of these deaths make international headlines. What made Jesse Gelsinger's death different was that it conveyed a powerful message: gene therapy is dangerous.

The FDA responded to the Gelsinger incident by halting all clinical gene-therapy trials at the University of Pennsylvania. New rules were instated for the reporting of adverse events. And adenovirus fell rapidly out of fashion in the scientific community as it became clear that the virus was the culprit in Gelsinger's death.

But with the message of danger came another, more subtle message: gene therapy is powerful. It wasn't quackery that killed Jesse Gelsinger, it was strong medicine—too strong. Someday, maybe soon, that power could cure.

The wait was not long. In April of 2000, Parisian researchers announced a definitive success in the treatment of two babies who suffered from SCID.

Within fifteen days of receiving gene-modified bone marrow cells, both the eight- and eleven-month-old infants began showing improvement. Their immune systems resembled those of healthy children of the same age, and when challenged with tetanus, diphtheria, and polio vaccinations, responded with the correct antibodies for each.

At the same time, doctors in California announced that two men who suffered from haemophilia B had shown dramatic improvement after receiving a gene therapy treatment. Haemophilia B sufferers lack a blood protein, factor IX. Without it, the blood does not clot properly, and even minor cuts can cause life-threatening blood loss. The standard treatment for haemophilia B is a regular regimen of synthetic factor IX injections.

Researchers at Stanford, in collaboration with California-based biotech company Avigen, used an adenoassociated virus to deliver a factor IX gene into the blood cells of three haemophilia B patients. One man was able to decrease his prescribed doses of factor IX by 80%, another by 50%.

These announcements came at a time when they were needed most. It was just six months since Jesse Gelsinger had died. Government regulatory agencies, including the highly influential NIH Recombinant DNA Advisory Committee (or RAC, usually referred to as "the Rack"), were scrutinizing the hazards of gene therapy with a new intensity. The public was slowly regaining confidence in gene therapy, after a decade of empty promises and the death of a teenager.

Three years later, a treatment that delivers a suicide message to cancer cells stands poised to be the first FDA-approved gene therapy for treatment of head and neck cancer. The vector? The much-maligned adenovirus.

Oh My God

The *gene-augmentation* approaches using retroviral and adenoviral vectors are merely the first wave. This first generation focuses on single-gene defects that can be corrected with the addition of a functional gene, usually through a viral vector, focusing on the affected tissue only.

But many scientists argue for a different strategy, *DNA targeting*, which

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seeks to repair the defective gene rather than masking it. This method can correct both loss-of-function and gain-of-function mutations.

For example, certain short pieces of single-stranded DNA can form a triplex with a DNA double helix. Researchers use this as a wedge to pry a gene apart and insert a corrected sequence. Another strategy is small-fragment homologous replacement, wherein the cell's natural ability to exchange copies of genes between chromosomes is used to swap a corrected 400- to 800-base pair sequence in to replace a defective gene. And a very exotic device called the human artificial chromosome (HAC), a relative of the biotech-industry staple, yeast artificial chromosome (YAC), bypasses the issue of genomic DNA entirely. At one-fifth the size of a normal human chromosome, it enters the cell fully loaded with as much genetic machinery as necessary to get the job done. . .

Tosk, Inc., a San Francisco Biotech company, has made one of the most intriguing advancements in gene delivery. Tosk uses a bit of fruit-fly DNA called the p-element to pop new genes in and out of chromosomes. Two characteristics of this Tosk *transposon* distinguish it from other gene-delivery methods. First, it's delivered by injection directly into the blood stream. Second, the transformation efficiency is as high as 80% in tissue cultures of human and mouse cells, a stupendous improvement over the 5% efficiency of standard transfection methods. Thus far, their primary use for this technology has been in the production of transgenic mice, made to order on-site for eight thousand dollars apiece.

Their newest vector, nicknamed OMG, combines the fruit-fly transposon with a gene-targeting approach for a potentially revolutionary, human-gene-therapy vector. OMG is short for Oh My God (which is what their researcher said when he realized the significance of his discovery). It uses homologous recombination to integrate genes into the host DNA. Homologous recombination occurs naturally during cell division when pairs of chromosomes exchange similar pieces of DNA. Tosk hopes to be able to market the vector as a method for replacing broken genes. If OMG fulfills its potential, it could make changing your genes as simple as donating blood during your lunch hour. (Or shooting up in a deserted alleyway . . .)

But standing in Tosk's way is the small matter of *germ-line* transmission. The same characteristic of the vector that makes it profitable in the production of transgenic mice, the ability to pass the gene to the host's offspring, makes it *undesirable* as a gene-therapy vector in humans.

The technologies discussed thus far affect *somatic* cells only, or those cells which are not involved in reproduction. The body's reproductive cells, the sperm and eggs, are *germ* cells. Genetic changes in these cells will affect not only the immediate patient, but any future descendants. So far, scientists have obeyed a voluntary moratorium on deliberate germ-line experiments, one enforced by the NIH and FDA. Although there are currently no laws against introducing new genes to germ cells, these two organizations, one holding the wallet and the other the leash, have prevented any such experiments from being carried out. Even stricter bans are advocated by such organizations as the Council for Responsible Genetics and the American Association for the Advancement of Science. Their arguments include concerns that genetic changes in the germ line could have unpredictable long-term effects, and, more importantly, that germ-line alterations would lead to undesirable social trends, similar to the pre-World-War-II eugenics movement.

Not all germ-line experiments are intentional. Although most somatic gene-therapy vectors are designed for and directed to specific tissues, they don't always stay put. Remember the Moloney

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murine leukemia virus that became a permanent part of the monkey genome?

In a trial of a gene therapy for treatment of haemophilia B conducted by Avigen, Inc., which showed so much promise in two early patients, vector was discovered in the men's semen. The RAC found the odds of germ-line contamination low and allowed the study to continue with the requirement that patients use barrier contraception.

However, animal experiments have shown that there is a risk. Lipid-encapsulated plasmid DNA has been used to transfer a bacterial β-galactosidase gene into mouse spermatozoa, and was ultimately found in the fetal progeny, a successful experiment in *deliberate* germ-line transmission. In another study, researchers injected a retroviral vector into mouse hearts, and later found the new gene in the offspring, demonstrating a definitive case of *inadvertent* germ-line transmission (IGLT).

In a document published on the NIH web site, the Biological Response Modifiers committee recommends the following procedures for preventing IGLT: routine and thorough testing of semen samples for the presence of vector gene sequences, suspension of new enrollment in trials where vector sequences are found in semen, and the use of barrier contraception by affected male patients until semen has tested clear for three months. Although these measures would seem adequate for a disease like haemophilia B, which affects only men, the outlook for female patients remains murky. The Biological Response Committee states, "The potential for assessing IGLT in women is especially difficult and, to date, no clinical studies have proposed sampling of female reproductive tissues." It seems like it's only a matter of time before the first germ-line gene-therapy experiments have been conducted through inadvertent germ-line transfer, since measures to prevent this occurrence range from minimal to none.

* * *

Faster, Stronger, Smarter

Few people realize that the first transgenic humans have already been born, perhaps several dozen, as the result of a new infertility treatment in which cytoplasm is harvested from a donor egg and injected into the mother's egg during *in vitro* fertilization. The children conceived thusly receive their mitochondrial DNA from the donor, and their nuclear DNA from their two parents; they have three genetic parents.

Although this manipulation of DNA is harmless by most standards, ethicists see it as a slippery slope leading toward a world with a "genetic divide" where the genetically wealthy will dominate economic resources and create a new class of oppressed people.

And as more new technologies reach clinical trials, these ethical issues will continue to trouble scientists. For example, what if a gene-therapy treatment became available for Huntington's disease? Huntington's is a particularly nasty inherited disease which strikes in middle age and kills quickly. Most victims don't show their first symptoms until it's too late to avoid having children. If a cure became available, and it could be given to Huntington's carriers in their twenties and thirties, shouldn't the repair extend to the germ line, so that any children conceived after treatment would also be disease-free? Or should the children be brought in for treatments of their own at the appropriate age? What if, at some point, the descendants of the original patient are not able to receive medical care? Wouldn't they be resentful? Angry? Litigious?

And so, we are forced to anticipate the needs of people who are unconceived. Never mind unborn. These people are simply a collective twinkle in the eye. Yet the development of gene therapy will force us to make policy, and even to make laws, that consider the needs of this nonexistent minority group.

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If we can correct a harmful or fatal genetic defect in a future child, the next logical step is the modification of genes that may not be dangerous, but are nonetheless undesirable, and beyond that, adding genes that *are* desirable, but simply lacking.

Ample evidence for this future social trend can already be seen in the field of somatic-cell gene therapy. Elective gene therapy is expected to make its debut at the 2008 summer Olympic games in Beijing, China, according to scientists at the Copenhagen Muscle Research Center. The International Olympic Committee and the World Anti-Doping Agency also have grave concerns about the possibility of gene doping in Olympic athletes. These organizations police the use of illegal performance enhancers at the Olympic Games and other international athletic competitions. It's an arms race in which the regulators are barely keeping up with the latest cheats. In 1998, an entire team was expelled from the Tour de France for using a synthetic form of erythropoietin (EPO). EPO boosts red blood cells, giving athletes an aerobic edge. Officials test for the synthetic form of EPO, but gene therapy would make it possible to dope with *natural* EPO, which would be undetectable. Other genes such as vascular endothelial growth factor (VEGF) have the potential to augment athletic performance.

It's not hard to imagine that some parents would be interested in giving these advantages to their children.

Five Card Stud

A number of parallel technologies are now coming on line that offer unprecedented mastery of our own biology: cloning and stem cell technology, the mapping of the human genome, *in vitro* fertilization, and gene therapy. There will come a day in the not too distant future when it will no longer be a neutral choice to live out your life with your original set of genes. It will be an act of religious faith, or contrarianism, or possibly even civil disobedience. Or maybe it will be no big deal, but people will still want to know *why*, in much the same way that expectant parents who don't choose to know the sex of their unborn child are expected to justify themselves. (How quaint and charmingly old-fashioned!)

For more than a century, the material of heredity has been considered immutable. Genes were the determinant of destiny. One could work within the limits handed down by nature, or counter the influence of a bad gene, but you couldn't change the genes themselves. Behavioral scientists beat the nature-or-nurture debate into the ground, all on the unstated supposition that if it's something to do with nurture, at least there might be some way to fix it.

Now, we must alter our attitudes to accept that genes are more like a hand in a card game, one that can be improved. Gene therapy started with the laudable goal of relieving pain and suffering, but it's in turn given us a huge responsibility—one that we don't want. After all, how can we possibly have the wisdom to manipulate our very genome? Better to leave it to God, or to nature, or to dumb chance. There is, however, no way to go back. Our only remaining choice, therefore, is to deal with the difficult, ethical issues presented by these new technologies, one at a time, and, at some point, gain the wisdom that is currently lacking.

Gregor Mendel would find the world of the twenty-first century bewildering. Many of the scientific principles for the technologies we take for granted today were in existence in 1865—electricity, combustion engines, germ theory of disease—but they had not yet transformed society. From his point of view, it would have been hard to see how these things would change the world.

We stand on the brink again, facing an enormous social change, and it's hard to see beyond the controversy, the dangers, the mistakes, and the waste of

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young lives like Jesse Gelsinger's. But gene therapy offers a hope for the future, as well. The hope that no more children will be born to live short, painful lives. The hope that medical science will be able to not only assist the body's natural healing process, but enter and make substantial repairs. And, as always, that the world will be a better, happier, safer place to live. ■

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About the Author

Catherine H. Shaffer lives and writes in the Detroit area. She has held the usual assortment of writers' odd jobs, including stable hand, veterinary assistant, molecular biologist, cashier, and full-time mother. She has published several non-fiction articles and one short story. Her interests include running, swimming, and blueberry picking.

ANALOG
SCIENCE FICTION AND FACT

SALUTES THE WINNERS
OF THE 2002 NEBULA AWARDS

BEST NOVEL
AMERICAN GODS
Neil Gaiman

BEST SHORT STORY
"Creature"
Carol Emshwiller

BEST NOVELLA
"Bronte's Egg"
Richard Chwedyk

BEST SCRIPT
The Lord of the Rings: The Fellowship of the Ring

BEST NOVELETTE
"Hell Is the Absence of God"
Ted Chiang

GRAND MASTER
Ursula K. Le Guin

AUTHOR EMERITUS
Katherine MacLean

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Paying it Forward

Michael A. Burstein

Legacies can take many forms. . . .

I'm dying.

No one knows it yet. Having never married, I have no family to mourn my passing. I do have my fans, who would probably turn out in droves to say farewell if I had chosen to let them know in advance. But in the twilight of my time, I want to face this final passage alone.

Of course, I'm not completely alone. I still have my mentor, Carl Lambclear. I'll email him tonight, and he'll email me back, and just remembering how much he helped me will keep me going until the very end. We'll exchange our latest story ideas, and share more turns of phrase that we both find appealing. Carl Lambclear is the one person I could open up to about my condition, and I'm glad that I did.

It's the ultimate irony, I suppose, that once more I find myself having something in common with Lambclear. He, too, is familiar with the emotional gamut that accompanies an inoperable brain tumor; after all, many years ago, he died of the same thing.

It started long ago, at the beginning of the century. I think it's almost impossible for anyone who didn't live through it to fully appreciate the swinging moods that the world experienced. For the months before and after New Year's Eve 2000, everyone all over the world seemed to harbor a quiet expectation that things would become new and different. The twenty-first century, a century of imagination and great wonders, was arriving, and optimism was the order of the day.

Of course, most of us sobered up after the economy tanked and September 11 happened and the other events of the ohs came to pass. With each tragedy, small or large, it was as if a curtain had plummeted down over another hope that was now irrevocably gone.

For me, the curtain came down when Carl Lambclear died.

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I was in my early twenties, a recent college graduate dealing with one of the worst economic downturns to follow a time of great economic growth. Despite a double honors degree in Chemistry and Physics, I couldn't find a job, and I didn't really know what I would do with one if I had one.

Because what I really wanted to do was write science fiction.

My parents had waited until their later years to have their only child; and, as an unfortunate consequence, they both died of old age while I was still in college. But fortunately, they had also left me enough of an estate to take care of myself during that difficult time. And that meant I had a chance to explore what I wanted to do with my life, rather than having to take the first job that came in my direction just to support myself.

I had grown up reading the great works of science fiction, pressed upon me by my father. Although in his later years his tastes had turned to mystery novels, he still understood the ability of science fiction to unleash the imagination of a teenage outcast. And I had been so captivated by the works of Asimov, Clarke, Heinlein, and all the rest, that I simply could not imagine doing anything else with my life but trying to bring that sense of the fantastic to others.

And so I had been trying to establish myself as a writer of science fiction. I'd published a few stories in small markets while in college, but to no great acclaim. While pursuing my formal degrees, I had studied writing informally by reading book after book on technique, plot, character, setting, and whatever else seemed useful. But one book I had devoured above all others: *Writing Short Science Fiction* by Carl Lambclear.

It wasn't just that I enjoyed Lambclear's novels. I also enjoyed his ability to teach, to explain how he created the worlds that he did in a way to make them fascinating. Lambclear had a lot of advice on how to draw the reader in, and the advice was just as fun to read as his fiction.

On the day he died, I visited his webpage, and read about all the new books he was planning. It's a strange phenomenon, I suppose, the dead leaving traces of themselves scattered around cyberspace as if they were still alive. Of course, I imagine people might have felt that way from the time the first person died who had a portrait painted. I remember reading mainstream mystery stories involving messages from beyond the grave, but not ghost stories and the like. There was nothing new about the idea of someone leaving a suicide note, or a clue to their murderer, but as technology progressed, the fictional and nonfictional deceased would leave answering machine messages, videotaped wills, and even emails set to go if a code word wasn't entered into a computer on a daily basis.

But for me, the spookiest of such messages from the dead were the webpages.

A personal webpage—even a professional webpage, come to think of it—was a vivid statement in the ether, saying to one and all that this person exists. To visit a webpage knowing that the subject of it is dead is like talking to a ghost, and hearing about all the tasks that the dead one left undone.

So, when I heard that Lambclear had died, it spurred me to visit his webpage. I had never done so before; odd, I suppose, given how much I liked his stuff, but it had honestly never occurred to me to do so.

So I pointed my browser (Microsoft's Internet Explorer on an iMac, connected via a 56K internal modem, if anyone still remembers those things) at his webpage and waited for it to download. The long amount of time it took surprised me. Most writers maintained webpages that were light on the graphics and easy on the text, which made downloading them rather fast, even over a simple phone line. But Lambclear's page dis-

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played elaborate graphics, and so I sat at my desk, staring at my computer screen and sighing as I waited for the bytelock to clear.

Finally, just when I thought my computer had frozen up completely, the browser bar filled all the way from the left to the right, indicating that the download was done. The picture on my screen made it evident why it had taken so long. Lambclear's webpage displayed a simulation of the control panel of a spaceship, with digital displays and blinking lights. As I stared at it, dumbfounded, my speakers started playing beeps and whooshes to go along with the effect. Windows on the control panel flashed funny messages, warning of strange anomalies, asteroids, black holes, and wormholes, and requesting that I make course corrections so I wouldn't hit anything.

I smiled. Although I doubted that Lambclear had designed the graphics himself, they did fit his style quite well. Lambclear wrote a lot of hard science fiction set on spaceships, rollicking adventure stories set against a rock-solid background of real physics.

Something else fit his style as well. The graphics were intense on the eyes, but they didn't make the webpage confusing to navigate. When I moused over all the graphics, nothing happened. Lambclear had placed a list of links to the other pages on the site over on the left of his main page, away from the graphic of the spaceship control panel. And each link was a simple word, such as "Home," "News," "Biography," "Novels," and "Bibliography." The link right under "Home" was to a site map, so I knew that despite the fancy setup, he wanted his information to be as accessible as possible to any visitors.

And on the bottom of the page sat a link that read, very simply, "Send me email."

I stared at it for a long time with regret. I had never emailed Lambclear, and clearly he had been interested in receiving feedback from his fans. If only I had thought of it before, I could have emailed him, let him know how much his work meant to me, and how much I wanted to emulate him.

But it was too late. Lambclear didn't even have a family to whom I could send my sympathies; he had remained a solitary bachelor until his last day. There was no one to whom I could properly express my appreciation for his work and my sorrow for his passing.

No one except . . .

I moused over the "Send me email" link and watched it blink back and forth between white and red. Finally, I clicked on it, bringing up my email program with the "To:" field already addressed to Lambclear's America Online account (again, does anyone still remember them?). For a brief moment, I felt silly—but only for a moment. I stared at the screen, looked out my window at the autumn leaves just beginning to turn on the trees, and then I composed this message:

Subject: Hello

Dear Mr. Lambclear,

I'm sorry I never got in touch with you before. I'm a big fan of your works, from the Ethereal Web stories to the Five Universes novels. I even have a copy of your first short story collection, *The Universe Off to the Side*, which my father gave to me as a birthday present when it first came out.

I doubt you've ever heard of me, though, and I hope you won't think it forward of me to write. (Your webpage did seem to invite email.) I've been trying to write science fiction myself, with no real success. I have to admit that I've been emulating you, with the hope that one day you might read my stuff and realize that we were kindred spirits—at least, as far as our tastes in writing.

I'm sorry that will never happen now. I do wish I had written to you sooner. Although I knew you were something of a recluse, the afterword in *Writing*

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Short Science Fiction seemed to indicate that you were willing to hear from your fans. But I just never had the inclination to write to you. In the back of my mind, I think I was waiting until I had published enough stories myself so I could approach you as a colleague. But I guess, as I said, that can never happen now.

I hope you can forgive me for waiting. Thank you for all your stories. You will be missed.

I clicked the SEND button on my computer screen, and the email went off to its destination. I felt better. Even though I knew that Lambclear could never know of my appreciation of him and his work, at least *I* knew about it, and that made a difference.

I went to bed that night feeling a little less sad about his passing.

A reader of this file, if anyone finds it, could probably guess what happened next. But as I write this, I still choose to approach the event slowly, like I did that long-ago morning.

My alarm clock went off at 7 A.M., blaring its grating tone as usual. I could have slept later, I know, but my parents had instilled in me a fear of sleeping away the days of my life. I pulled myself out of bed, walked to the kitchen, and brewed a cup of fresh-ground Colombian coffee to help me wake up. Still in my blue chamois pajamas, I sipped from my father's old porcelain mug, sat down at my computer, and downloaded my email.

And among the voluminous spam and occasional email from friends, I found a reply from the account of Carl Lambclear.

At first I was confused, and I almost choked on my hot beverage. Lambclear was dead; how could he have replied to my note? Perhaps a friend was cleaning out his mailbox. Or maybe Lambclear had set his computer to send out automatic replies, acknowledging receipt of email. Whatever the reason, I knew an obvious way to find out: Just open the email and read it.

I hesitated, as unwilling to resolve my situation as the familiar quantum cat. So long as I left the email closed, I could imagine that Lambclear lived; but the moment I opened it, I would come face to face again with the bald fact of his death.

I shook my head, sighed at my own silliness, opened the email, and read it. And when I came to the end of the email, I leaned forward and read it again and again.

Subject: Re: Hello

Dear fellow traveler,

It was an absolute delight to receive your missive from yesterday. As a matter of fact, I have heard of you. I keep up with all the magazines, even the semi-pro ones, and I fondly recall one of your stories. If my memory does not fail me, yours is the story about the young girl who runs off to join an interstellar circus. Good stuff, even if the writing is a bit awkward in places, and the plot a little thin. But writing weakly is a phase we all must pass through, and within your story I do espy the seeds of better work.

However, the point of my reply is not to criticize your work, as I would hesitate to do so without a formal invitation. Rather, I am writing to tell you of my gratitude in knowing how much my work has meant to you. It may surprise you to hear this, but in point of fact I do not hear from many of my fans, even those who would aspire to join me in my calling. I presume most people are put off by my reputation of reclusiveness, and are therefore hesitant to intrude upon my privacy, no matter how delicately they might.

But I must admit, now being in the autumn of my life, I find myself more willing to be an active participant in the world than I have been before. And since your letter arrived at this propitious moment, I feel that perhaps I owe

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you a little bit of the assistance that was offered to me at the beginning of my career. I would like to offer you the same help, giving you advice on your own stories in the hopes that you will grow to be the best writer that you possibly can.

In other words, if you are willing, I would be more than happy to begin a correspondence.

Sincerely yours,
Carl Lambclear

After reading the message three times, I leaned back slightly in my chair, sipped my coffee some more, and pondered. The email was impossible. Lambclear was dead; notices of his death had appeared on all the usual places, including the *Locus* and SFWA webpages. Lambclear could not have replied to me; therefore, by simple logic, someone else must have done so, pretending to be Lambclear.

But who would have done that? For a moment, I had the fleeting thought that perhaps Lambclear actually did have a family. Was there a secret wife who replied to my message? Or maybe a secret child? But I dismissed that notion as quickly as I came up with it. It simply didn't make any sense, given the tenor of the reply.

Still, someone must have been reading his email, and whoever it was seemed intent on playing a joke on me. Rather than fall into the trap, and be made a laughingstock, I carefully composed my next email to dissuade the prankster. It went like this:

Subject: Re: Hello
Dear "Mr. Lambclear":

Whoever you are, this joke is in poor taste. Both you and I know that there is no way in the world Carl Lambclear could have responded to me. All I meant to do was express my appreciation of his work, and you poked fun at me for doing so.

Leave me alone.

* * *

I sent it out within the hour, and then spent the rest of my day writing. I managed to get my thousand words done, not bad for the day's work. And, as was my habit, I refused to check my email while working. I knew too many aspiring writers who had fallen into that trap and never written a word.

Furthermore, that night I had no time to read my email after I finished my thousand words, as I went out on an unsuccessful blind date. The date was disastrous enough that I still recall it today; still, the less said about it, the better. So the next morning, when I once again was drinking coffee in front of my computer, I found another ostensible reply from the account of Carl Lambclear.

I sighed, thinking that this was absolutely ridiculous. I had already told off the anonymous person who had emailed me the first time; I didn't really want to have to go through this again. I highlighted the email and prepared to delete it. And then a random piece of advice flitted into my head and stayed my hand. Some writer once said that any experience, no matter how bad, was fodder for the typewriter. Perhaps this message might lead to a story idea. At any rate, it couldn't really harm me just to read it.

So I clicked on the email, opening it. And read the following:

Subject: Re: Hello
Dear fellow traveler,

I must admit being somewhat perplexed as to both the tone and the content of your last message. Here I am offering you a chance for personal feedback from me, and you react with hostility. From what you said in your first note, I was under the impression that you found my work enjoyable. Was I mistaken? Should I have not written back with the gratitude that I did?

Please rest assured that it was indeed I who responded to you, that no one was poking fun at you, and that I am in fact Carl Lambclear.

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However, if I do not hear from you again, I will assume that you wish me to leave you alone, as you so explicitly indicated in your last sentence.

Sincerely yours,
Carl Lambclear

It was only after I read the email that I noticed the attachment accompanying the message. Normally, I would approach an attachment from a strange email address with wariness, but curiosity took over. Besides, people never usually wrote computer viruses for Macintosh computers, so I figured the file would yield no problem.

I opened the file and began reading it. After a moment, I choked. Lambclear, if it really was he, had written a critique of "Alien Circus," my story about the young girl who runs off to join an interstellar circus.

At first, I felt insulted. How dare this person, pretending to be Lambclear, take it upon himself to criticize my work without invitation?

Then I began to read the critique.

The writer, whoever he was, had made some very cogent points about the flaws in my story. As I continued reading, I felt my anger melt away. The writer's gentle phrasing and spot-on analysis rendered me more grateful than upset. Lambclear clearly knew what he was talking about—he showed great insight in his comments—

I shook my head. When had I decided to think of this person as Lambclear?

I reached the middle of the document and stopped reading in order to ponder its existence. If I had written to Lambclear but a year or two ago, and gotten this email in reply, I wouldn't have questioned its veracity in the slightest.

And yet, how could Lambclear have sent me this email today, given the incontrovertible fact that he had died? Could he possibly still be alive? He wouldn't perpetrate a death hoax, would he?

A thought occurred to me, prompting me to open the first message I had sent Lambclear. I noticed something interesting; I had never mentioned in my note that Lambclear was dead. It didn't seem important at the time, but now I wondered. Could whoever it was have taken my email as an invitation to give me the mentoring I so desperately wanted?

And the funny thing, the two emails did sound like him. I went back to his book on writing and some of his essays, and the style felt very similar. I considered hiring someone to do a textual analysis of the two emails and the critique to prove that Lambclear was really composing them, but it didn't seem worth it. Kind of like killing a fly with an atomic bomb.

Still pondering and puzzled, I returned to the critique to see what else he had said about my story. My thoughts flipped back and forth over the question of whether or not Lambclear himself could have written this document.

And then, when I finished his critique of my story, I saw something that clinched my belief that my correspondent might in fact be Lambclear. I pulled *Writing Short Science Fiction* off my shelf again, and riffled through the pages, until I came to the page I remembered.

In this book on writing, Lambclear had given the subconscious mind a name. He called it "George," and frequently noted that George would tell him to do this, or George would tell him to do that. Well, in the critique of my story, he ended with this piece of advice: "I suggest you get in touch with your inner George." Now, the possibility existed that some other close fan of Lambclear's work had written that final sentence. But it seemed unlikely, especially when taken together with all the other evidence I had that Lambclear himself had written back to me.

And yet . . . rationality said otherwise! How could I reconcile the fact that Lambclear was dead with the fact that he was writing to me? I had grown up a ra-

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tionalist, an agnostic, a skeptic in the face of superstition. How could I believe that I was now corresponding with the dead?

I wrestled with what to do for few hours, finding myself too distracted to write fiction. Finally, I wrote another email:

Subject: Truth
Dear Mr. Lambclear (?),

Thank you very much for your critique of "Alien Circus," and for your willingness to reply. I only wish I had had the opportunity to run the story by you before it saw publication! Still, some of your comments suggest to me the possibility of a sequel, which I feel would have a higher quality than the original story. And so it goes, I guess.

You must have noticed that although I removed the quotation marks from around your name, I've added a question mark in parentheses afterwards. Please do not take that as an insult, only as a representation of my confused state. You see, after reading your critique, I am convinced of a few things. I am convinced that you understand the art of writing very well, and that you also have great skill as a teacher. I am also convinced that you have a deep understanding of the field of science fiction, and what makes a story evoke that sense of wonder we all strive for.

And yet, for reasons I do not want to mention explicitly, I find it extremely difficult to believe that you really are Carl Lambclear. Not to be insulting, but there are compelling reasons for me to believe otherwise. I hope you will understand what I mean, and still be willing to continue this correspondence that I may have inadvertently started. But I further hope that perhaps you can tell me something to clear up my confusion.

The email sent into the ether, I returned to my daily quota of words. I recall how sometimes the critiques I received in writing workshops would make me freeze up for days on end, unable to write anything. It pleased me to discover that Lambclear's critique had the opposite effect. I zipped through my thousand-word quota, and even doubled it before I declared my working day over.

And the next morning, when I checked my email, I found another message from "Carl Lambclear."

I noticed he had changed the subject line.

Subject: What is truth?
Dear fellow traveler,

I am delighted to see that you have come around somewhat, and are willing to accept the fact that I am who I say I am. (I remind you once again that you were the one who initiated our correspondence, not I.)

I must admit, I haven't received too many emails recently; or at least, not emails of any major interest. I suspect that most people doubt I would bother replying, for those same "compelling reasons" to which you obliquely referred. But you, my young friend, chose to write to me anyway, and for that, I hope to repay you.

Essentially, I plan to share with you seeds of story ideas that might blossom under your tutelage. My wish is that you grow enough in your talent to be able to take these story ideas and make them uniquely yours. But let me begin with an idea that is uniquely mine, and which is also one that might make you feel better about corresponding with me.

Let us posit the following scenario.

Suppose a writer knew he was dying. An older writer, but not one who has yet reached what most would consider the twilight of one's life, but rather just the autumn. Such a writer might feel many things: desperation, anger, and fear are the obvious ones, although one cannot omit the possibility of feeling peace or a sense of completion. A psychologist could discount that, however, and sug-

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gest that the writer might even go through the five stages of dying: denial, anger, bargaining, depression, and finally acceptance.

But the writer might do something else instead. Suppose that writer was also a Ph.D. physicist and an expert computer programmer, and he wanted to make sure that he would be remembered. What might he do? How does a person with a technical background and a ceaseless imagination deal with the inevitable conclusion of his existence?

I know that such a scenario must be light-years away from your own mind, but that makes this all the more interesting a challenge. If you can figure out my idea, you might have the makings of an excellent spinner of tales of science fiction.

Sincerely yours,
Carl Lambclear

I didn't know it then, but this was only the beginning of the meat of my emails with Lambclear. Lambclear called it "Campbelling" a story, named after the most influential editor in the field of science fiction. John Campbell would give story ideas to his writers, and ask them to write the stories. They would take his ideas and run with them; for example, Isaac Asimov's "Nightfall," which was once voted the best science fiction story ever written, was based on an idea given to him by John Campbell. Lambclear loved to throw ideas in my direction, and over the years, many of my most well-regarded stories had their roots in Lambclear's suggestions. I suppose I could come clean now, and point out which stories of mine came from Lambclear's suggestions and which didn't, but I think it is best if I do not. I have to leave *something* for the scholars to argue about, after all. (Ah, a writer's ego rears its ugly head once again; why should I assume that future scholars will have any interest in my scribblings?)

But I'm getting ahead of myself, because on that long-ago night when Lambclear first sent me a story idea, I had no idea where this would all lead. Picture me as a young, confused writer, who still had no idea what Lambclear was getting at. I suppose I could have terminated our correspondence right there and then, or just emailed him back innocuously. But the idea had created some deep feelings within me, and I decided to make my distress evident.

Subject: Re: What is truth?
Dear Mr. Lambclear,

I'm afraid I'm totally at a loss as to how to develop that idea you're suggesting. In fact, I'm not quite sure why you're even suggesting it to me in the first place. After all, if it's just a story idea, why not write the story yourself? And if it's more than a story idea, why hint at it in such an odd way?

I actually have more experience with death than you may expect or realize. You see, although I'm just out of college, both of my parents have passed on. I was there for each of them, and I helped my mother and my father go through their struggles before dying.

Furthermore, Dad was a scientist, much like yourself, and Mom a computer programmer. So to suggest, as you did, a story idea in which someone with technical expertise finds himself dying—well, it hit me a little too close to home. Literally.

My guess, though, is that you didn't know. Otherwise you wouldn't even have suggested that idea. But maybe this is why I'm having trouble spinning fiction out of your idea.

Or maybe I'm once again having trouble dealing with the question of who you really are.

Please stop playing games with me. Just be up front and let me know what's going on.

Subject: Re: What is truth?
Dear fellow traveler,

My first reaction to your latest note was to sigh, as I felt heavy with guilt of

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unintended actions. I truly did not mean to bring up any unpleasant memories. As you ascertained, I knew nothing of your family background, and had no idea that your parents were deceased. Please allow me to offer my sympathies, belated though they may be.

That said, I do feel obliged to point out to you what you must have already learned if you have truly read my book on writing. The best stories come from deep within a writer's soul. The death of your parents may hurt you deeply, so deeply that you choose to withhold your emotions; but if, instead, you were to tap that resource, you would probably find a rich vein of story ideas that would never be depleted.

In any event, I reread "Alien Circus" and it reminded me again that you do have a talent I could nurture, even if it is still in its most rudimentary form. (Please do not take that as an insult; even well-established writers need constant nurturing, and the more mature and comfortable writers are with their level of talent, the more they understand and accept this.)

So let me help you with the development of the story idea I suggested. Again, the question I posed is: suppose a writer with a strong background in Physics and Computer Science discovered he was dying? What might he do?

To my way of thinking, the obvious answer is that he might try to find a way to stave off the grim reaper. Our field has plenty of examples of stories of immortals, or near-immortals; and yet surely, our field could support many more. So I played on this idea for a while, and came up with my own conclusions.

The first thing that such a person might do is attempt to download his personality into a computer, so that he could continue living. Of course, as a few philosophers have been quick to point out, that doesn't necessarily mean that the writer himself would continue to feel alive. Instead, others who interact with the computer program would swear that the person was alive and intelligent, so his influence would live on in an explicit way even if he himself did not.

But, sadly, current technology doesn't yet allow for an actual uploading of a mind; our brains are still far too complicated for us to understand that completely. However, if our imaginary writer had the skill, he might write a computer program that could simulate himself as a rudimentary form of artificial intelligence. Perhaps even as an AI which could pass the infamous Turing test.

(As a side note, it seems to me that the writer, relying only upon his own judgment, would program the computer with only his best qualities, and leave out the worst. After all, we all imagine ourselves to be nobler than we really are.)

Doesn't that strike you as a fascinating idea to play with?

Ah, but I hear you ask: what else? What other ideas come to mind?

Well, try this one. Suppose this writer, having a background in Physics, figured out a way to connect his computer to another universe via a wormhole. Perhaps travel between universes is not possible, but communication is. If so, it might take the imagination of a science fiction writer to make it work. Could that writer arrange for all his incoming email to fall through that wormhole and end up in the mailbox of another version of himself? And might that version then pick up his communications where the original one was forced to leave off?

Think on it, my young friend.

Sincerely yours,

Carl Lambclear

Subject: Re: What is truth?

Dear whoever,

Are you saying you're a Carl Lambclear from another universe? Are you saying that you're a computer simulation of the Carl Lambclear who just died? WHO ARE YOU?

* * *

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Subject: I am that I am
Dear fellow traveler,

I believe the standard reply on the Internet is ROTFL, for the phrase "Rolling On The Floor, Laughing." Nowhere in my email do I mean to imply that what I wrote is the truth! My idle thoughts were merely an exercise in speculation, nothing more. I'm not saying anything about the real world. I'm just doing what we science fiction writers always do, positing scenarios and generating story ideas.

Of course, you may choose to believe what you wish, but remember the curse that falls upon the heretic. I dare say that if you took these bizarre insinuations to anyone but myself, they would look at you askance and inquire as to what weed you were smoking. Those who would hang on your every word are probably also those with whom you would be most reluctant to share these ideas.

I will finish this email with the following offer, reiterated. I find myself with much time now, and can think of no better way to use my time than to help you along. If you would have me as your mentor, I would have you as my pupil. I only ask that you no longer question me on how and why, but accept this for being just what it is.

Sincerely yours,
Carl Lambclear

I took Carl up on his offer, and with his help, my writing blossomed. I managed to crack a few minor markets at first, semiprozines and webzines, until finally I figured out how to make a story work for a larger audience. And then, by the purest luck, I managed to catch the wave of the science fiction renaissance, the so-called Second Golden Age.

My stories were some of the first to appear in *Analog*, *Asimov's*, *F&SF*, *Absolute Magnitude*, and *Artemis* when the kids who had grown up on the fantasies of J.K. Rowling and Tamora Pierce suddenly turned to science fiction to satiate their appetites for that undefinable sense of wonder. Of course, these things do come and go in waves. Eventually, the wonders seemed pedestrian again, and the circulation and sales dropped as they had many times before. But they will grow again at some point in the future; of this I am sure. As it says in Ecclesiastes 1:9, "That which has been is that which shall be; and that which has been done is that which shall be done: and there is no new thing under the sun."

After having cut my teeth on short stories, I finally began publishing novels. My novels sold well enough for me to make a living, and garnered me some minor critical acclaim, even an award or two. And so the years passed. I need not recount them here in any sort of excruciating detail; anyone interested can refer to *The Scenes of Life*, the autobiography I uplinked just ten years ago in 2060. My estate will surely find the royalties useful for settling old debts. Instead, I turn now to the end of the tale, the last few emails I shared with my mentor.

The emails in which I finally unearthed the strength within my soul to tell Carl Lambclear the truth.

Subject: Cancer
Dear Mr. Lambclear,

I'm dying.

I didn't want to tell you this news. I know how much we've avoided talking about death, ever since the beginning of our emailing back and forth. I suspect I know why, and I'm sure you do too.

It's particularly disheartening, because the reason I'm dying is that I have an inoperable brain tumor. There is an irony in all this, I suppose, but again, I wouldn't feel right pointing it out to you. Not after all these years of your help and guidance.

I know I have very little time left; unfortunately, I have no way of knowing exactly how much. I must admit that part of me feels the need to ask you how you managed, after—well, you know

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what I mean. But the other part would hesitate to dispel the magic, and so I refuse to ask for a peek at the man behind the curtain.

The email sent, I went back to my bedroom to try to get some sleep. The pain came and went, but by popping THC and plugging my head shunt into the wall, I managed to doze off and even have a few pleasant dreams of old friends.

My EC chirped, waking me up, and called out the time in a flat monotone. "Eleven twenty-two P.M.," it said. The middle of the night. I gently creaked out of my bed, pulled my tattered blue robe around me for warmth, and glided into my living room. The wall screens remained dim, due to the lateness of the hour.

"Messages," I called out. Perhaps it was old-fashioned of me, but I never wanted the whole house connected, just this one room, which was why I had to leave my bed for the alert.

"You have twenty-seven messages," the room said.

"Delete all spam."

"You have one message," the room said. As I had expected.

"Display," I said.

And the screen on the walls turned bright with Carl Lambclear's final message.

Subject: Re: Cancer

Dear fellow traveler,

So it has come down to this. In the end, we really are fellow travelers.

I am truly sorry to hear your news. I still remember my first reaction when I found out about my own terminal condition. You may recall how I refused to let anyone know about my cancer until I had finally passed on. My agent was good at keeping secrets, and she handled the announcement and the estate matters very well, or so I have always felt since.

Because we are fellow travelers, my young friend (and may I still call you young?), I understand your feelings. We strive for immortality, all of us, in our myriad ways. Some of us run for public office, in the hopes that we will change the course of the world. Some of us teach, in hopes that out of the thousands of students we encounter, one will blossom. Some of us get married and have children, so that a little bit of us will survive in a fellow human being's DNA. And some of us create, whether it be art, music, poetry, or stories, in hopes of communicating to the future that once we were here, and that once we mattered.

In the end, however, from dust we sprang, and to dust we shall return. Even I was not immune to that, however much it may seem otherwise from our years-long correspondence. You know that I died, or at least a version of me did; and that is something you were never able to shake, no matter what.

But, as I said, I feel greatly for you. And so, at some expense to myself, I have decided the time is ripe to provide you with my solution. I have sent you an attachment to this email. I assure you that it is not a virus, nor anything of a malicious sort.

For reasons that will soon become clear to you, I am afraid that I will be unable to continue our correspondence for much longer. And so, having taken note of your salutation lo these many years, I would like to offer you one final hand of friendship. After all, we are no longer mentor and student, if we ever were. We have long passed into the roles of colleagues, equals in our field. And so, we should address each other as such.

Feel free to call me Carl.

Sincerely yours,

Carl

I read Lambclear's—I mean Carl's—note with tears welling up in my eyes, until I could no longer see. I removed my glasses and wiped them on my robe,

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and then the house brought me a tissue and I blew my nose.

Eventually, I managed to regain my composure, and I took a look at the attachment Carl had sent me.

I am not now, nor have I ever been, a computer programmer of any sort. Even today, when one programs the more complex computers by simply telling the less complex computers what you want them to accomplish, I still would have no idea what I'd be doing.

Nor am I a physicist, despite my degrees. My education is so far in the past, in any event, that I can barely understand the mathematics of the cutting-edge theories proposed today.

But I am a science fiction writer of many years, and I can comprehend certain concepts far better than the ordinary person. And as a science fiction writer, I am now prepared to accept even the most outlandish ideas that others might dismiss out of sheer mundanity.

Carl's attachment was a computer program. He had sent me the same program he had created shortly before he died, the program that allowed him to communicate with me. I tried to decipher it at first, but the coding was far too obscure for me to grasp.

Fortunately, Carl's program was filled with comment lines, laying out every step of what it did. The comments made it trivial to command my system to execute the program. And as an added bonus, I now know just with whom I was communicating all these many years, and I no longer have to guess if Carl's emails came from an artificial intelligence, from another universe, or from something or somewhere else that no one could ever guess. Because in the comment lines, Carl explained how he had managed to apply the Tegmark Hypothesis.

Max Tegmark, a physicist who did much of his work at the turn of the millennium, when I was just out of college, had proposed an interesting take on the Many-Worlds interpretation of quantum mechanics. Many-Worlds, proposed by Hugh Everett in 1957, explained away the paradoxes of quantum uncertainty by postulating that every time a decision has to be made, the universe splits into two, yielding an infinite multitude of realities, sometimes referred to as the multiverse. Well, Tegmark looked at this bizarre concept and proposed an even more bizarre idea of his own, which came to be known by his name.

The Tegmark Hypothesis can be summarized as follows: The only realities you continue to be aware of are those in which you survive.

In other words, suppose you do an experiment where you ask an assistant to push a button which will randomly cause a machine gun to either fire or not fire. You position yourself exactly in front of the gun, so that if the gun fires, you have no chance of surviving.

Here's where quantum mechanics comes into play. It is certainly possible for your assistant and for the rest of us to observe the experiment and recoil in shock at the sudden explosion of a bullet into your chest. But because there are an infinite number of tracks upon which the universe can run, you yourself will never feel the bullet. For you to be a valid observer, your consciousness must follow a track along which it will never—can never—be snuffed out. The alternate way to phrase the Tegmark Hypothesis is this: You can never have any awareness of realities in which you are dead.

Carl's program opens a connection to computers in other universes, and seeks out the universe in which "I" continue to live, forever and ever. The program will reach that version of me, and explain to that version exactly what is happening to me, in my universe—which is, of course, the only universe which matters to me. The program will bring a message about my life to my other self, and propose that my other self keep the memory of my existence alive in this

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particular world, doing exactly what Carl started doing those many years ago.

And so now I know what I must do. Webpages are years in the past, of course. We no longer surf websites on the World Wide Web; rather, we visit Holosites in the Universal Database. But email, in whatever form one calls it, is still the same.

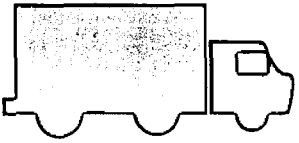
Carl's program was easy to download into my own machines. I do not have to wonder if it scans my files and reproduces an artificially intelligent copy of myself, for I now know that it does not. Nor do I have to concern myself with the entropic problems of creating a gateway into another universe, for that gateway is only for computers to navigate. And because I know what will happen, it no longer matters to me that Carl's program cannot keep my "me-ness" intact. Within a week or a month, I know I shall be gone, and in the meantime, I must keep my shunt plugged into my system. Although it may be immodest of me, I imagine that on the day I die, some young fan who aspires to write will visit my site and will see the recently installed link that encourages fans to email. I imagine that the fan will hesitate, just as I did so many years ago, and then decide to send one more email into the ether, as a tribute to the author of that fan's admiration.

And when that happens, my system will be ready. Carl's program is set, and the young fan will receive "my" reply. With luck, my encouragement will spur my correspondent into a full-fledged calling as a writer. Another, immortal, version of myself will help that fan, in the same way Carl helped me and generations of writers beforehand helped him. All of our influence will be felt throughout the centuries. And none of us will be forgotten.

It pays to pay it forward. ■

—For Charles Sheffield, Damon Knight, and all the rest.

MOVING?



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ONLY ON TV

Some of you may know that I was a contestant on the *Who Wants to be a Millionaire* TV show right when it was at the peak of its prime-time popularity. This was back in the winter of 2001 and there hasn't been much reason for me to mention anything about it, except that the Space Shuttle *Columbia* disaster occurred about a week ago as I write this. Aspects of my trip to New York City—the events that happened along the way, the people with whom I came into contact—I think can shed light on that calamity.

So here's what happened.

I have my wife to thank for getting me on the show since I was not a devotee. I'd seen my share of episodes, so I knew what it was all about, but it was Dorothy who would find out when to call to try to become a contestant.

The qualifying procedure (at the time I made it) was to phone in, answer some multiple choice questions similar to those used on the show, and, assuming you answered them all correctly, wait to see if you got a phone call back.

One time, they called back.

The guy on the phone took some personal information and gave me a PIN number and a time to again call the show. When I did that, I had to answer another series of questions correctly. Shortly thereafter a delightful young woman named Lisa called, told me I'd made it, and that she was to be my producer. There followed a few days of calls and e-mail exchanges for information gathering on their part, but soon enough, plane tickets for two arrived.

Though most contestants take their wives along, Dorothy wanted to stay home to watch the kids, knowing that then I wouldn't worry about them while I was gone. I chose as a traveling companion my good friend Richard (who had also helped me move both to and from New Hampshire—I owed him).

We flew to Chicago to catch a connecting flight to New York City. That flight was uneventful.

Then bad things started to happen.

Chicago to NYC is a couple of hours' flight. It took longer. We flew through and above cloud cover for a long time; the flight crew mute as to what was taking so long. Eventually, still in the air after our scheduled arrival time, the pilot told us the plane was circling around Philadelphia because New York was enjoying a blizzard. Finally we started our descent, or so we thought.

Oops—never mind—too much snow in New York. We were diverted to Syracuse because the plane needed fuel and the airline had to figure out what to do with us. We waited on the runway for ages before the plane pulled up to a gate. Once in the terminal, Richard went to the front desk and I to the telephone to call my travel contact. The show had a woman who actually lived at the hotel where the contestants were lodged; her entire job, to troubleshoot travel problems.

Smart thinking!

I told her I'd keep her apprised of my

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situation, then found Richard. The airline staff at Syracuse still didn't know what the hell to do with us—it was as if they'd never had to deal with two planes at the same time.

Time dragged. I was ticked off—part of the glamour of the show was that I was to be in NYC early to relax and have some fun before the taping on the following day. Instead, I was kept cooling my heels in an airport while rude and inept "customer services representatives" made us displaced passengers feel guilty for asking what was to become of us.

Eventually it dawned on someone from the airline to order pizza and soda for us. Then they told us they'd get us to NYC tomorrow or we could go back with the plane to Chicago. But they weren't going to recheck our luggage—that would go back to Chicago.

Let me highlight this luggage matter a bit.

"Yes, you're in Syracuse instead of New York City," they acknowledged. "No, we can't get you to NYC before tomorrow. We can get you back to Chicago, though. No, we can't get your luggage off the plane."

"Let's see if I've got this straight," I say. "You've got all the baggage handlers, you've got all the baggage handling equipment, you do this for every scheduled plane that lands. But you can't do it for passengers who arrived unexpectedly (despite having had hours of notice that we were on the way)?

Enough of this shit, I thought. I called my contact. Oh, she was good! She told me to give her fifteen minutes and then call her back. I did. She'd gotten Richard and me train reservations, told us to catch a cab to the station, and that the show would reimburse me for everything once I arrived.

We found a cab. We were already late for the train, but, as is not uncommon, the train was also late. We climbed aboard with what little luggage we still had, the train pulled out of the station, went something like a hundred feet, and stopped. "Derailment up ahead," we were told.

Eventually the long ride started, boring as hell, until I caught Richard staring at the five-digit car number above the door.

"What are you looking at?"

"That number. I think it's prime."

Aaauurrggghhh! We spent the next hour or so trying to factor it with other primes. (I think it *was* prime, by the way.)

After midnight, we rolled into NYC, exhausted, all hope of a fun afternoon in The Big Apple gone forever. Much of the snow from the blizzard had already melted, the city itself being a big, warm machine. I met my travel angel at the hotel, we got our rooms, and were told that the clothes we had wouldn't pass muster for the show. We'd have to buy new clothes tomorrow. (They have strict rules for what contestants and guests can wear—we knew this and had packed accordingly, but our good clothes were back in Chicago.)

The next morning, while the rest of the contestants for my night went off to the studio, Richard and I hastily went shopping. My pants were serviceable, so I only needed a shirt, but he needed everything. I found a shirt and we split up, I going to our room to change, and he hitting one last store. Richard was gone a long time when suddenly he burst into the room. "I have some good news and some bad news. I got clothes, but my wallet was stolen!"

There being nothing to be done about that, we went to the studio, led over by a producer who made sure we were properly taken care of despite the problems brought on by travel disasters.

Being at the studio was entirely different from the real world outside. I met my producer Lisa, who was a beautiful and highly professional young woman. She interviewed us for "bio cards," little cards the host, Regis Philbin, could use in the event I made it to the "hot seat." Richard and I noticed that all of the pro-

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ducers were attractive and highly professional. They all made us feel like we were the center of the Universe. That's impressive when you remember that tomorrow they were going to have to make a whole new set of people feel the same way.

Richard and I separated, he going to do what it was they did with guests, and I going to see what it was like to actually be onstage answering questions. The producers had one creed—the contestants are the stars of the show. They really made us feel that way. And they really wanted us to succeed. They told us to speak up if anything was wrong, or made us uncomfortable—they even offered tips for how to use our three "lifelines" (if you get stuck, you can poll the audience or phone a friend or have your four multiple choices reduced to two).

After practice and lunch, we contestants were whisked away to makeup and to have wireless mics affixed. I got to talk to some of my fellow contestants, share stories of who we were and how we got there. Several were quite impressed that I was a writer with a book out (I had packed two copies of *Dykstra's War*, both of which were back in Chicago with my sport coat and nice clothes).

We taped the show. I didn't win, but I had fun. I was resolved to treat the whole trip as the prize, and the show itself, and the chance to win money, as the icing. I got the first lightning-round question wrong. I didn't like it when my name didn't light up as one of those who had at least answered correctly, even if not first. I resolved to make sure I got the answers right after that—Science Fictiondom was counting on me!

I had two more shots, and though I wasn't first, at least I was right. The last question involved putting in order by date of debut four TV shows, none of which I had ever watched. But I did it! Put that up in lights!

With the taping over, it was time to relax. The following day the show had allowed us until 3:00 P.M. to enjoy NYC, and we did. My agent, Joshua Bilmes, and one of my lifelines, Shane Tourtellotte, met up with Richard and me and we had breakfast and visited the Museum of Natural History.

Once home (after a thankfully uneventful flight) I discovered that folks were much more impressed that I had been on the *Millionaire* show than that I'd written a novel.

Back to the present. Every day there's an update about the *Columbia*. NASA engineers don't know if the heat shield tiles were damaged on liftoff or later in the flight, or if something else was wrong. One thing upon which all of the engineers seem to agree is that there was no way for the astronauts to look at the tiles while in orbit, not via a space walk, nor even with a camera on a boom. And besides, we are told, even if they could look, there isn't anything that they could do about it.

Uh, hello? And NASA feels comfortable *admitting* this to us?

So let's see if I've got this straight—we've only been doing space walks since the 1960s, but we couldn't do one of those. Any kid on the planet can have a webcam on his PC, but we can't put one on the end of a stick to look at the bottom of the shuttle.

Who needs the "cold equations" for drama when this kind of stupidity fails to raise an eyebrow?

Contrast the attitude of NASA and the airline with that of a TV game show, a make-believe world where people have actually heard the expression, "shit happens." A world where it is thought prudent to have a person available to troubleshoot travel problems, even before problems have happened. A world where competent people perform their duties cheerfully, politely, with deft efficiency, where the attitude is "can do," and not "couldn't do it."

Yeah, I know. Only on TV. □

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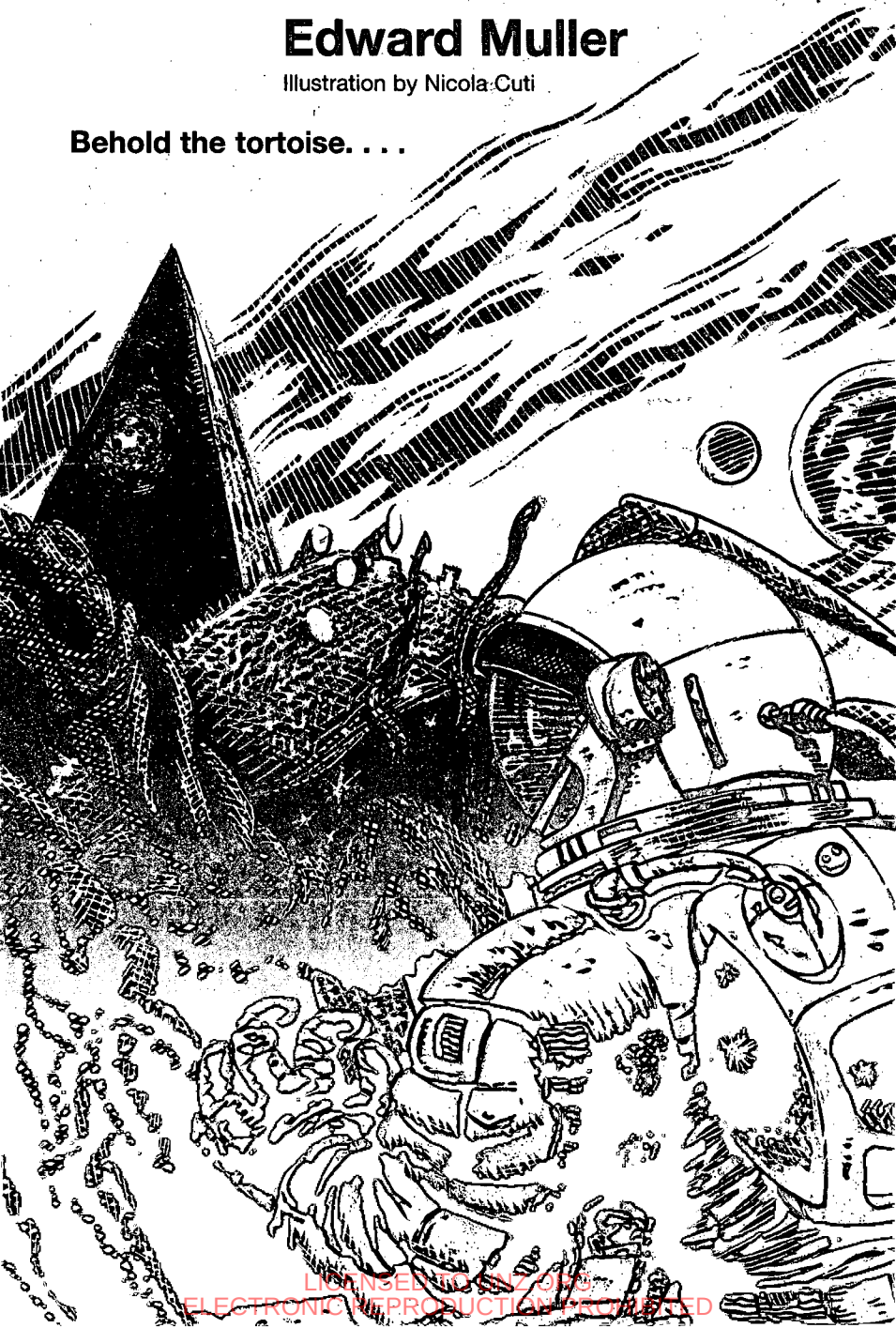
The First Lesson

Edward Muller

Illustration by Nicola Cuti

Behold the tortoise. . . .



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Five minutes into the restricted area, the frantic human voice of Director Ling replaced the increasingly strident warnings of Tobias' spacesuit.

"Tobias, what the hell do you think you're doing?"

"I'm going inside the vault," Tobias replied with a casualness he didn't really feel, as he hoisted himself further up the cliff face. Another few meters and he would reach the top of the plateau.

"Are you mad?" Ling asked him after a barely noticeable lightspeed delay. "The Guardian will kill you!"

"Not if my theory is right."

"And if it's wrong?"

"Then the Guardian will kill me."

The edge of the restricted area coincided with the base of the plateau upon which the vault stood. As his head cleared the top of the plateau, Tobias beheld the vault: A tetrahedron, a three-sided pyramid a kilometer and a half high and formed of a single, solid piece of a material whose structural strength exceeded that of diamonds. Decades of exposure to New Thebes' hurricane-force sandstorms had failed to put so much as a single nick in the vault's mirror-smooth surfaces. It looked just the same as it had in the pictures the first robot probes to visit the Alpha Centauri A system had sent back more than a century before.

No, Tobias corrected himself, *not quite the same*. Over the past few decades, a circle of wreckage had slowly built up around the base of the vault, the diced remains of dozens of robots that had ventured too close to the vault and been destroyed by its robot guardian.

Tobias pulled himself onto the top of the plateau.

"Tobias, I know this is a difficult time for you. I was eighteen myself once."

Sounds like he's getting advice from a psychology program, Tobias thought. He recognized the telltale cadence in Ling's voice. All adults spoke like that when they started parroting advice from the base computer. Tobias could have easily forgiven Ling for his lack of skill in dealing with young people. It was a rare thing for a child to be born these days, now that human beings were getting used to immortality. He suspected the only reason his parents had had him was to provide the crew of the *Heyerdahl* with a distraction during the long and tedious trip from Sol System. What he found unforgivable was that adults thought him too stupid to tell when they were trying to manipulate him.

Tobias started walking. He made good time. New Thebes had less than a quarter of the two gravities he'd grown up in, the increased gravity of the station being a clandestine way to get the researchers there to exercise.

Even from six hundred meters, the vault entrance was visible, a triangular opening in the vault wall at ground level. No one knew what the opening led to. The material of which the vault was made was impervious to every scanning technology humans possessed. The only clue about the contents came in the form of an inscription on the vault face in English that read: *This vault contains the rarest thing in the universe and the first lesson you must learn if you are to join us.*

As Tobias walked towards the vault, Ling related a story from his own childhood, something about getting his driver's license.

"So you see," Ling finished, "If I'd just been more patient, I would have gotten what I wanted a lot sooner."

Several seconds of silence followed.

I know you want me to answer you, Tobias thought. *Tough. I talked at you for several months and you never listened to me.*

"Tobias, I know from your suit's telemetry that you can hear me. You're being very immature."

Prerogative of youth, Tobias thought.

"Look, I've read your proposal."

Took you long enough, Tobias

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thought. He'd written that proposal five months ago. He'd followed all the rules only to see his ideas summarily rejected. After all, he was only an eighteen-year-old boy. His thinking was addled by hormones he hadn't enough experience with yet to adequately control.

Sometimes you've got to take a risk to prove you're right, Tobias thought. Nobody had taken Thor Heyerdahl's theories about how Polynesia had been settled by people from South America seriously until Heyerdahl sailed the distance on a reconstruction of an ancient balsa raft, to prove it could have been done.

"It's an interesting idea," Ling said. "We could send a robot with a human DNA sample."

"Already done," Tobias said. "There were skin flecks on the last ten probes we sent in. Only a living human being can pass by the Guardian. Whatever's in there is meant for human beings and human beings alone. The fact that the vault inscription is in English is proof enough of that."

"If you have no regard for your own life," Ling said, "then have some for my career. If you're killed, I'll be blamed."

The argument nearly stopped Tobias. At least Ling was being honest now.

Keep going, Tobias told himself. *Being immortal means you'll have the rest of eternity to regret your mistakes.* If he gave up now, they'd make certain he could never try this again. Better to take the chance. *You'll regret it if the Guardian kills you, but if it chops you to bits in less than ten seconds, your regrets won't last anywhere near as long.*

"For the record," Tobias said. "This isn't your fault, Director. You had no way of knowing I'd do something like this."

Outside the debris ring lay another ring of robots: sentries who did nothing more than sit and watch the vault. As Tobias neared that line, the nearest of the crab-like robots suddenly rose up and moved to block his path.

This has to be Ling's doing, Tobias thought. He tried angling to the right, but the robot moved to block him.

Haven't got time for this, Tobias thought. The robot wouldn't need to delay him long. Tobias didn't doubt there was a ship already heading down to pick him up. This was his best and only chance. He needed to get inside the vault before that ship arrived. The robot had its two arms spread wide. It wasn't attempting to grab him, just bar the way. It hadn't been designed to restrain humans.

Tobias backed up several steps, then ran right at the robot. Two meters short of the robot's arms, he jumped.

A combination of heavy-gravity muscles and low local gravity wasn't enough to completely clear the robot. Tobias came down hard on the robot's top shell. He immediately jumped off again. The robot didn't react. Whoever had ordered it to block him probably hadn't anticipated he would pull that particular stunt. The lightspeed delay would also work in his favor. It would take a second or two for the people above to learn what he'd done and send new instructions to the robot.

Tobias landed and started running as fast as he could. He resisted the urge to look back. Doing so wouldn't help.

Four hundred meters remained between him and the vault entrance. He couldn't hope to outpace the sentinel over that distance, but he was hoping he wouldn't have to. He was only twenty meters away from the outer edge of the debris ring, the limit of the Guardian's domain.

A flash of motion at the vault entrance gave Tobias renewed hope.

The Guardian reminded Tobias of a mirrored-silver centipede with wicked spikes growing from each of its body segments and a set of front pincers that could snip through carbon composite armor as if it were balsa wood.

The Guardian flew past Tobias' right side faster than his turning head could follow. The Guardian disabled the sentinel robot with a few strategic snips to

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its legs. Normally it would start in on shredding it, but only if there wasn't another robot moving inside its perimeter.

Uh-oh, Tobias thought as the Guardian turned around to face him. He turned his head back and ran. Two strides into his run, something heavy landed on his back and bore him down to the rusty dirt. A strange vibration swept down through his body. It was probing him. Tobias had some hope. Normally the Guardian didn't take this long to attack.

Something jabbed into his upper back.

Surprised more than hurt, Tobias cried out.

"Tobias?" Ling yelled over the radio.

The weight on Tobias' back vanished. When he finally regained enough of his wits to move, he felt at his back. His fingers didn't detect anything through the heavy fabric of his gloves. Tobias unclipped a camera from his belt and pointed it at his back. An overlay on his helmet visor showed what looked like a puncture in his suit sealed with a substance that looked like brown resin.

"I'm okay," Tobias said. "The Guardian was just a little rough taking a DNA sample from me. It's backed off me now. I passed inspection."

"We'll be there in ten minutes," Ling said. "Stay where you are."

Like hell I will, Tobias thought. *I took the risk, I'm getting first look at what's inside.*

He walked through the vault entrance. It led to a downward-sloping ramp. Tobias followed it down, his suit lights coming up automatically as the light faded. The ramp switched back on itself three times before ending in a tetrahedral chamber. A round pedestal rose from the center of the chamber floor. Upon the pedestal stood a gold statuette. It looked like a baby-cute cartoon version of a human being. The hair on its head rose to a point. He'd seen something very much like it in pictures of his grandmother's doll collection.

Tobias picked up the statue. It had the heft of solid gold and appeared to be nothing more than a solid piece of metal.

This is it? Tobias thought. All that mystery and worry over a solid gold Kewpie doll?

Turning the statue over, Tobias noticed an inscription set in the base.

The rarest thing for you now is the thrill of the unknown. Give way to your fear of death and you condemn yourself to a hell of eternal boredom. This is the first lesson you must learn if you are to join us.

Tobias smiled as understanding came to him.

"You're right," he told the statue.

Tobias emerged from the pyramid a few minutes later, just in time to get hit by the sandstorm from Ling's shuttle touching down outside the debris ring. By the time Tobias cleared the distance between the vault opening and the shuttle, the sand had settled down again. Ling hurried down the ramp built into the shuttle's front landing leg and met him halfway.

"Here it is," Tobias said, offering Ling the statuette.

"You shouldn't have touched it!" Ling said, as he took careful hold of the statuette. "You might have damaged it."

"It's nothing more than a solid gold paperweight," Tobias said. "Analyze it all you want, you won't find anything more."

"I see," Ling said. "Having proven yourself right once, you're now an expert on everything."

"Not everything," Tobias said. "Just this one thing. Look at what's written on the bottom."

Ling turned the statue over. After a few seconds, he looked back up at Tobias and said: "Lesson?"

"Lessons are really nothing more than warnings from people who made mistakes. As different as they were from us in appearance, the builders of the vault must have gone down the same general

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path of technical evolution that we've just started on. They must have found a way to cancel the genetic self-destructs in their bodies, same as we have. They got into the habit of sending mechanical probes out ahead of them everywhere they went to ferret out any possible danger, same as we have."

"And they grew bored as hell," Ling finished. "Same as some of us have." He looked at Tobias. "I must confess, this *was* the most excitement I've had in the last fifty years, and I wasn't even the one risking my life."

"We can all easily feel that alive again," Tobias said. "All we have to do is stop sending robots out ahead of us."

Ling nodded thoughtfully.

"Tobias?" he said a few seconds later.

"Yes?"

"If you're right, then what do you suppose the second lesson will be?"■

You don't tell deliberate lies, but sometimes you have to be evasive.

—Margaret Thatcher

The right word may be effective, but no word was ever as effective as a rightly timed pause.

—Mark Twain

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Pale Horse

Kevin Levites

New technologies
may make it even harder
to tell who is the object of an action. . . .

He was well-known to the prison guards, and they gave his clergy papers only a cursory once-over while they buzzed him past the maximum-security lockdown doors.

He nodded pleasantly as prisoners beseeched him during the long walk to the end of the cell block, and found himself doing the assembly line blessing gestures that he so detested—if a priest was going to bless someone, it should be done with patience and love, not with hurried gestures done in passing.

He promised himself that he would spend the next day on his knees praying to God for the souls of the doomed men, but that was for after his mission.

The guards made him wait behind the transparent barrier while the prisoner was shackled and secured. It was an involved process, as the prisoner was a multiple murderer and a serial bomber, and no one wanted to lose their career over a dead priest.

There was a horrible haunted look in the man's eyes, and deep regret.

"They tell me that you've accepted Christ."

"I have. They say that acceptance washes away all sins, but I'm still scared. I'm scared of what they'll do to me."

"I know. My faith is strong, but I don't think I'd hold up as well as you have."

They sat in silence for a while, basking in each other's company. "Can you get on your knees and pray, or do the chains prevent it?"

"I can. Joe; he's one of the guards that's always nice to the condemned men. I told him that I wanted to pray, and he talked his partners into giving me a little slack."

They got on their knees and prayed, and the priest offered to hear the condemned man's last confession.

The priest made a quiet gesture, and Joe nodded as he thumbed a wall switch.

"Good," said the priest. "A proper

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Confession is privileged information. They eavesdrop for security reasons, but I enjoy the same power of privacy that your attorney has. Do you understand?"

"I do."

"Fine. Now we can get down to business."

"What do you mean?" asked the condemned man as confusion registered in his eyes. "I've been sentenced to Judicial Hell. It would have been better if I had gotten life, or even a quick execution. What possible business can we have when I'll spend an eternity in torment?"

"God provides, my son. Have the microtendrils been causing problems?"

"A few headaches here and there, but nothing I can't handle. At least not compared to where I'm going."

The synaptic microtendrils were implanted a week before, and they were constantly providing surveillance over the trillions of dendritic connections in the prisoner's brain. Their purpose was not to punish or kill, but to provide information so that the condemned man's mind could be downloaded into a virtual environment after his state-sanctioned execution.

"I might be able to help you, but you have to want to be helped, and it won't be easy."

"I'm still confused, Father. You know where I'm going, and what they're going to do."

"I know, my son, but there are a lot of us—not just Catholics, but Jews, Buddhists, Protestants, Muslims—who don't believe that Man should usurp God's judgment. Maybe God will condemn you to Hell, but at least it won't be because of some human—and fallible—judge."

"You mean I might—"

I don't know, my son. I can still help, but the decision has to be yours."

"I don't understand."

"I'm going to tell the guard that Confession is over, and he'll turn on the sound. Then we pray a little more—each of us asking for forgiveness, but for different reasons."

"Then what? God rescues me?"

"Yes, in a strange way. I'll give you absolution and you will eat the wafer, just like at Mass."

"Then what?"

"A few hours will pass, and the enteric-coated cyanide will disrupt your vital functions, and you'll keel over as dead as a doornail—as dead as your many victims. They won't have enough information to download you into Judicial Hell as a software entity, and everything else will be between you and God."

Any concern that the priest had about the man's soul banished with the next question.

"What about you?" asked the convict.

"I'll be long gone. They'll mount an investigation, but my organization has a few friends who'll protect me. A lot of people are against Judicial Hell, and not just for religious reasons. A good many people make a living devising new and exotic forms of torture for the penal system, and we think it brings out the worst in everyone. There are even college courses on virtual torture design in the larger computer schools, and it makes me sick."

"They say that time moves slower in Judicial Hell because everything is all electrons. Even if they destroyed the hardware tomorrow, thousands of years will have passed between now and then."

"True. Are you ready for Communion? We haven't got much time."

"I am."

The priest signaled the guard to resume surveillance, and Joe flicked the wall switch.

The priest intoned the ancient ritual of God's forgiveness, and the prisoner swallowed the holy wafer with gratitude in his eyes.

Joe showed him out of the prison, and winked when the priest nodded at his St. Christopher's medal.

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"I'm not ready for Communion, Father. At least not with your wafers."

"How—"

"Shhh. I didn't trust him not to hurt you, so I only looked like I flicked the privacy switch. I left him some extra slack in the chains so he could kneel, and I didn't want him to abuse the favor by taking you hostage. I could get into a lot of trouble if they found out what I did.

"After all, Confession is privileged information, and I wouldn't want to get in trouble for violating a prisoner's rights."

The arms of the easy chair were lightly bleached with many years worth of fugitive's sweat, and Father Carmichael wondered how many people had taken refuge in this particular safe house. He knew not to ask in any case, as Father Ramsey would never tell him.

"It's been all over the news, Father. I'll bet you're glad that we've granted you Sanctuary. How many is it now? Fifty-seven?"

"Fifty-eight, if you count the odd heart attack that felled Lansberg a month ago."

They both smiled at that one. Emil Lansberg was a sociopath who was convicted of raping and murdering twenty-two college girls over the course of a decade, and had jumped on Father Carmichael's offer of suicide as an alternative to Judicial Hell. The exotic poison—a modified version of a substance found only in the skins of certain tropical frogs—had escaped detection despite an exhaustive autopsy.

"Does it ever bother you?" asked Father Ramsey.

"Why should it?"

"Well . . . we both know that Judicial Hell is nonsense. A copy is only a copy. You might as well treat a prosthetic arm the same as a real one. Why should we concern ourselves with a government swindle if it keeps people in line?"

"Let's talk about that," replied Father Carmichael, after a moment's thought. "I was a police officer before I became ordained, and I remember a debate over an assault case that has bearing on Judicial Hell.

"We responded to a stabbing, and we arrived only to discover that the perp had stabbed a disabled man in his prosthetic leg. The perp was stoned out of his mind, and the victim pushed the assailant into the path of an oncoming car."

"Good for him," said Father Ramsey.

"I know. Well—there are different degrees of assault, and the fact that the man had been stabbed in a fake leg presented some problems. Was it assault with destruction of property? If the victim had been stabbed in his real leg, we could have charged the perp with assault and battery—which is a much more serious crime. Was it battery even though the perp never made physical contact with the victim? We weren't sure."

"How did it turn out?"

"My chief consulted the district attorney, and we charged him with assault and battery. We got away with it, too, and the dirtbag ended up doing more time."

"How did they make it stick?"

"It was because of the Americans with Disabilities Act. We decided that we couldn't treat the victim any differently because of his handicap, and the jury bought it."

"What does that have to do with Judicial Hell?"

"Sometimes a copy has to be treated like the real thing. Look—if I go without drinking fluids for five days or so, I would probably die. I have to constantly replace lost water with new water if I want to live, and this same idea applies—more or less—to every single one of the chemical substances that composes my physical body. In this sense, I am only a copy of a younger man that existed in the past. A gradually made copy to be sure, but a copy just the same."

"But what about your brain cells?

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They don't reproduce."

"No, but the brain is an energetic organ. A few pounds of tissue uses up almost half of the oxygen that a person breathes. There is a constant flow of nutrients into a nerve cell—and an equal flow of waste products in the other direction. I'll bet you anything that you care to wager that the material that makes up a nerve cell has been turned over many times in a person's life, so this idea about an adult being a copy of a younger person still holds."

"But consciousness is—"

"—is what?" interrupted Father Carmichael. "Nobody really knows what consciousness is, because it's so private. I don't believe that man can condemn a human soul to eternal torment within a computer mainframe, but I can't rule it out. I still maintain that our underground movement is a humanitarian mission, and I believe in our cause."

"You'll get no argument from me," said Father Ramsey. "I was just playing the Devil's Advocate."

"A traditional role for a Jesuit."

They both laughed, Father Ramsey poured them snifters of brandy, and they toasted their mission.

The black-clad figures moved silently across the roof of the safe house. Their padded shoes made no noise as they deployed various listening devices. The leader recorded what she wanted—made a gesture—and the rest of the SWAT team readied their weapons.

Judicial Hell was a mixed blessing to law enforcement. There was a real deterrent value, so there was less crime—but it also made criminals more dangerous once they were cornered, and the leader of the SWAT team didn't want any mistakes that could hurt her men.

The Jesuits were definitely not to be underestimated.

Father Ramsey left on an errand, and Father Carmichael found himself alone in the safe house—wondering how many people had been granted Sanctuary and what their crimes were.

His thoughts were interrupted by an implosion of glass from the front window, and he found himself surrounded by black-clad figures that seemed to bristle with weapons.

He slowly raised his hands with a sardonic smile and winked at the SWAT leader.

"I was wondering what was taking you so long."

She reacted fast.

"Goddamit! Did you see him wink? He knows something we don't!"

This galvanized the SWAT team.

"Get him out of here and scan the area for bombs. If you find a device, don't assume that it's the only one. These religious fanatics are experts in esoteric poisons, so I want you to check your dosimeters frequently—they've been known to use nerve gas.

"Now move out!"

Father Carmichael was cuffed and led away, smiling quietly to himself. There were no bombs or booby-traps, but the SWAT leader was absolutely right.

He *did* know something that they didn't.

Father Ramsey came to visit him on Death Row after the trial, and Father Carmichael smiled when the guards let him in with his wafers, and remembered that Joe was on duty.

"So—you want to tell me why you deliberately retained the services of an incompetent attorney? The whole world believes that you murdered those condemned men."

"I know. I wanted to be found guilty."

"But why? So I could give you absolution before you keel over from cyanide?"

"Not quite. I want to be downloaded."

"What for? Is that why you called in the anonymous tip? I still haven't figured that one out. Do you know how much you've hurt our cause?"

"Before I answer that, I need to know

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something. Did you bring my special wafers? The ones I kept in the safe-deposit box?"

"Yes. Why did you tell the bank that that your name was Dante Alighieri?"

"It's an inside joke. Those wafers are rather special. All you need to know is that the flatness of a computer chip lends itself to concealment within the Host."

"What do you mean?"

"I mean that I'm going to revive an ancient practice—long downplayed by the Jesuit Order and the Roman Catholic Church—but applicable in my situation."

"Which is what?" asked Father Ramsey.

"The Rite of Exorcism."

"You mean—"

"Yes. Now, shall we begin?"

"Delighted to," answered Father Ramsey.

"Bless me Father, for I have sinned . . ."

The computer virus from the most recent download paralyzed the system, and there was a collective, electronic sigh of relief as many thousands of software entities got erased. ■

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SECTION SEVEN

John G. Hemry

To hold an interstellar empire together requires maintaining uniformity in some very mundane matters. But how can you do that when it's impractical to use force across such distances?

Valentia looked beautiful from orbit, but then most planets did. Foster gave the world a weary traveler's worth of attention as the lander glided down, reflecting that from a great distance you couldn't encounter temperature extremes or rough terrain or the bites of bugs that wanted to eat you even if they couldn't digest you. Not to mention encountering the people, who were always the source of the particular problems Foster dealt with.

The customs official barely glanced at Foster's standard ID before feeding it into his desk scanner. A moment later, the ID popped back out onto the counter where he could pick it up.

"HaveanicestayonValentiaMr.Oaks," the official mumbled before reaching for the ID offered by the next traveler.

Foster retrieved his ID, took two steps past the customs desk, and found himself facing a trio of individuals wearing dark uniforms and stern faces. One of the port police officers held out her hand. "May I examine your ID, sir?"

"Uh, of course." Foster let his own expression show an appropriate level of surprise and a hint of worry as he fished out the ID again. "Is something wrong?"

The officer took the ID and slid it into a portable reader before answering. "Just a random check, Mr. Oaks. Valentia wants to make sure all travelers have good stays here. What brings you to Valentia?"

Foster smiled with the practiced enthusiasm of a sales professional. "I represent Inner Systems Simulations. You've heard of ISS?"

The officer's responding smile was both polite and brief. "No. Sorry."

"We make some of the finest entertainment software. Just in the Inner Systems right now, but we want to expand our market. If you'd like, I can show you some of our—"

"That won't be necessary." The officer removed the ID from her scanner

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and returned it to Foster. "Have a nice visit to Valentia, Mr. Oaks."

Foster smiled back with the same degree of professional insincerity, though his smile could've been genuine. Posing as a sales professional had numerous advantages, not the least of which was the ability to drive away questioners by beginning to offer a sales pitch. It never hurt to cut short an interview, even though his false IDs couldn't be spotted by any scanner and his cover story was solid.

Outside the port terminal, Foster squinted against the brightness of Valentia's sun. He hailed a cab by raising one hand in a gesture understood everywhere humanity had gone, directing it to the short-term rental business apartment complex where Mr. Oaks had his reservation. Foster didn't bother looking around for anyone tailing his cab, since that would have been a tip-off he thought he might be followed. Instead, he watched the scenery roll by with every appearance of boredom.

Foster checked in, went up to an apartment whose interior decoration could've placed it on any of a score of worlds, and swiftly changed clothes. The Valentian styles in his bag hadn't aroused any suspicion at Customs, since many tourists didn't want to look like tourists. A few minutes later, he was leaving the apartment complex by a different way than that he'd entered through. A brisk walk took him to a restaurant, where he paused to examine the menu in the window while also checking the reflection for anyone following him. There weren't any apparent candidates, but Foster took the precaution of checking for tails in two other restaurant or shop windows before entering an establishment promising authentic Italian cuisine using the finest native Valentian ingredients.

Like all sit-down restaurants, it had restrooms. And like most restrooms, these were located near a service entrance. Foster had no trouble leaving via that entrance, then crisscrossing further into the city before finally entering a hotel and registering there as Juan Feres using another one of his IDs. Only after reaching his room there did Foster actually unpack.

His data pad linked to the local net with some difficulty, causing Foster to frown. Once linked, he located the local classified ads and searched for the one he wanted, one advertising antique Beta videotapes for sale at prices too high for anyone to be interested. Foster called up on his data pad an e-copy of a venerable novel entitled *Dykstra's War* and went to the page that correlated with the Standard Federation Julian Date. The prices and titles of the Beta tapes provided coded links to words on that page, giving Foster a phone number in the city.

The phone number was answered by a recording. Foster waited until the ancient sign of the beep sounded and spoke his message. "Juan here. I'm at the Grand Frontera Hotel, Room 354. I have a message from your sister Kelly on Innisfree."

Then Foster waited. After a bit, he began wishing he'd paused long enough to pick up some of the authentic Italian/Valentian food. Room service provided an overpriced and overcooked plate of "authentic nachos" which in addition to chips and cheese, included some sort of small fish filets and what appeared to be a raw egg cracked into the center of the plate. Foster sighed, chewed some of the latest stomach-calming medicines available in the inner systems, then ate carefully around the egg or whatever it was. Dealing with local tastes in food was just one of the occupational hazards of his job.

A soft tone announced his room had received mail. He checked the message, ensuring its enthusiastic response included the counterphrase needed to confirm it'd come from his Valentian contact. Referring to *Dykstra's War* again, Foster decoded the information in

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the reply to find an address in the city.

The local mapping system balked at working with his data pad, causing Foster to frown again. He finally got the directions he needed, saw his destination was too far to walk, and headed for the public transit system, carrying his bag along. It didn't do to leave bags unattended in hotel rooms if you could help it. Especially bags whose shielded, wafer-thin concealed compartments contained a variety of false IDs as well as other useful materials.

Sitting on the subway gave Foster a decent excuse to idly glance around. None of the other passengers seemed to be suspicious, and none left at his stop. Foster nonetheless took a circuitous route to his destination, weaving back and forth along several blocks and checking unobtrusively for tails, before finally reaching the doorway of a private residence.

A nondescript man of medium size and build answered Foster's ring. "Hello. Are you Juan?"

"That's me. Wide and free from Innisfree." Foster winced internally at the code phrase. He didn't make them up, but he had to say them.

"I wasn't sure Kelly had left Barbadan. Is she still engaged to Collin?"

Foster nodded. "Now and forever."

Sign, countersign, and counter-countersign exchanged, the man let Foster in, closing the door carefully behind them, and led the way into the house, bringing Foster to a nicely laid-out library room and closing that door as well before speaking again. "I'm Kila. Jason Kila. Welcome to Valentia."

"Gordon Foster. This room's secure?"

"Tight as a drum. No one can see or hear us."

Foster sat in the nearest chair and leaned back, relaxing for the first time since he'd arrived on Valentia. "Can you bring me up to date?"

Kila sat down as well and shrugged. "Not much has changed since my last report. Just more of the same."

"I noticed compatibility problems with the local software."

"Oh, yeah. They've got this operating system they claim is easier to use and more reliable than Federation standard, and also fully compatible. Some of the stuff in it *is* easier to use, other's harder. I don't know about the reliable part. I do know it's less and less compatible every time they tweak it."

"We'll have to take care of that."

Kila grinned, his lips drawing back to expose his back teeth. "You've got authority to act?"

Foster nodded. "Once I've heard everything. What else?"

"Here." Kila fished in one pocket, then tossed a small object at Foster. "Local ammo."

"Hmm." Foster frowned down at the bullet. "It's too small for 9mm and seems too big for 5.6mm."

"Right. Good eye. It's 6.8mm."

"Six point eight?" Foster let exasperation show. "Why the hell are they producing ammunition incompatible with Federation small arms standards?"

Kila rolled his eyes disdainfully. "They wanted one round for pistols *and* rifles. So they picked something smaller than a 9mm pistol round and bigger than a 5.6mm rifle round. They call it universal ammo."

"Universal?" Foster laughed. "They create a new ammunition type incompatible with Federation standards and then label it universal? I guess I should give Valentia credit for sheer gall."

"Yeah. Between the operating system and the ammunition, we've got a slowly accelerating gap developing between Valentia and the rest of the Federation. There's already talk about altering the mass transit gauge 'to better suit local conditions.' It's all in my report."

"What about the Federation demarches to Valentia demanding conformity to standards? Has there been anything about those in the local press? Any public debate?"

"Nope." Kila shook his head for em-

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phasis. "The government's sitting on the demarches. There's been a few questions raised about diverging standards, but they're very isolated. Most locals don't see it as anything to worry about."

"Okay. Valentia thinks they can sit in their own little corner of the Federation and do whatever they want." Foster flipped the bullet back to Kila.

Kila snagged the shiny object and eyed Foster. "Pretty much. What do we get to do about it?"

Foster turned up the corners of his mouth in a humorless smile. "We get to mess with a few things."

"Yee-hah. When do we start?"

"Right now. Have we got a software engineer on planet?"

Kila nodded. "Of course. Janeen Yule. She's very good."

"Give her this." Foster slid open the heel of his shoe, revealing another shielded compartment, and removed a data coin. "It contains a worm called Black Clown."

"Black Clown?" Kila took the coin gingerly, turning it over between two fingers. "What's it do?"

"It makes things harder. Have Yule make any necessary changes to match it to Valentia's new operating system. Once we introduce it onto the Valentian net it'll propagate like crazy."

"The Valentian firewalls won't stop it?"

"No."

Kila clearly wanted to ask more, but simply nodded. "I'll get it to Yule. Are you sure you don't want to hand it off personally? Yule might have some questions for you."

"If she does, you pass them to me. I want to maintain tight compartmentalization of this operation. I don't need to know what Yule's local cover is."

"You're the boss." The coin disappeared into Kila's clothing. "What about the ammunition?"

"I'll need access to the fabrication module controllers in the manufacturing facilities. For the ammunition, and for the firearms the Valentians are building to use that stuff."

Kila's brow furrowed for a moment. "You'll need to work directly with one of our on-planet people for that. Not Yule. Jane Smith."

"Jane Smith?"

"Yeah." Kila grinned. "Her real name sounds like a cover name. Jane's burrowed into the Valentian bureaucracy. She can get you that access and not leave any fingerprints."

"Cool. It's good to have a friend in the bureaucracy."

Kila smiled again, then looked at Foster questioningly. "Speaking of bureaucrats, I heard that rumor again. The one about our pensions and stuff not being honored because officially we don't exist as Federation employees."

"There's no truth in that. We're covered. Every one of us has an official and totally innocuous identity within the Federation government. I've personally confirmed that. Those identities have nothing to do with our real work, but they're accruing all the benefits we're entitled to."

"All of us? Everybody in Section Seven?"

Foster frowned and held up a warning hand. "That doesn't exist," he reminded Kila in a soft voice.

Kila looked like he was trying to eat his last words. "Damn. Sorry."

"Just don't say it again."

"I won't. I never say it. I don't know why I said—"

"Said what?"

"Why I said . . ." Kila finally got the idea. "Nothing. So, it's a go?"

"Yes. I'll stay at the Frontera a few more days and then shift hotels. Is the number from the classified ad good for contacting you routinely?"

"Now and then. Don't worry about coming by here. It's a mixed business and residential district, so there's always lots of foot traffic. You won't stand out."

"Good location. Nice work."

Foster met Jane Smith two days later

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at a public park. She wore nice but not flashy business attire which made her look more professional than attractive. "Tatya Ostov. Bureau of Inspections."

"Pleased to meet you." Foster felt a data coin slide into his palm as they shook hands.

"Yes. I understand you've come from the Genese Islands to help out in my branch. I appreciate your help, Mr. Danato."

"I'm glad to be here, Ms. Ostov."

"Your first inspection is set for tomorrow. Please report in to the bureau front desk first thing in the morning. I'll go over your schedule then."

"Thank you." Smith/Ostov left, and Foster made his way to the next-closest library to pop the coin into his data pad. It contained all the information he needed to memorize about his role as Julio Danato, facilities inspector from the isolated Genese Island chain brought in temporarily to help eliminate an inspection backlog at the bureau.

Foster appeared at the Bureau of Inspections the next morning, where the security guard scanned his ID, then handed it back with a bored nod. Security forces on every planet fought to ensure all identification data was compiled in a single place in order to assist their investigations. That also meant only a single place had to have false information inserted in order to mislead security forces. Naturally, security forces always insisted their ID sites where hack-proof. They were always wrong.

Smith greeted Foster with cool politeness. As Ostov and Danato, they went over an intensive inspection schedule, covering a wide range of manufacturing facilities. "You need to check to make sure all equipment is operating within proper tolerances and all safety requirements are being followed," she advised. "You have authority to access any equipment and systems necessary to do that."

Foster nodded, noting as he did so the small arms and ammunition manufacturing plants buried among the other facilities he'd have to inspect. "I won't have any trouble. This a pretty extensive list, though. I may have to work late a lot of nights to complete it in the time I have."

Ostov smiled with patent insincerity. "You're a salaried employee, Mr. Danato. It comes with the territory. If you have any questions or run into any difficulties, please give me a call."

Foster started work the next day. While analyzing the list of facilities closely, he'd discovered Jane Smith had arranged it so that he'd be hitting all the places associated with arms and ammunition late in the day. He'd have to put in a special mention about her foresight once this mission was over.

Most of the facilities he inspected had nothing to do with his real task, but provided cover for the ones he needed to reach. He plowed through the Bureau of Inspections checklist at each location, grateful that the Valentians hadn't yet diverged from Federation standards on manufacturing equipment and related software.

By the time he reached the first targeted facility, the week and that day were drawing to a close. Managers eager to get on with their weekend waved him onward as Foster assured them he could conduct his checks without their having to stay late.

His work would've been considerably more difficult in early industrial days when physical jigs and forms were used to guide the manufacture of parts. Instead, Foster accessed the controllers which would direct computer-guided fabrication of the parts for the new "universal standard Viper personal sidearm." Tolerances were tricky things. If they were adjusted just a tiny bit, everything would still look fine, and initially any test weapons would work okay, but within a short time, parts wouldn't work well together. It'd take a while to figure out there was a problem, time during which manufacturers would inevitably claim operator error. If the controllers had a hidden worm cycling tolerance vari-

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ances from part to part on a random basis, identifying the cause of the problem would be even more difficult.

Foster finished his work, closing it out without leaving any fingerprints within the controller software. He'd changed the master patterns and their backups, so the only way to eventually fix the Viper pistols would be to redesign them. By that time, they'd hopefully have as bad a reputation as Foster could hope for.

Another week went by, with another small arms facility and an ammunition plant included among Foster's bevy of inspection sites. His dry, routine reports were forwarded to the bureau and buried within its data files, though not before Smith in her supervisor's job altered the identifiers on a few to make it look like someone else had inspected some of the arms facilities.

Foster was having a late lunch at a store cafeteria when he noticed an increasingly large and impatient crowd in the payment line. A heavy-set man at the front of the line was drumming his fingers on the counter as he stared at a flustered clerk trying to ring up his charge. "What's the problem? I haven't got all day."

The clerk mumbled what sounded like curses. "Excuse me, sir, I'm having trouble getting the system to accept your data."

The man glowered. "There's nothing wrong with my credit status."

"No, sir. It's just not accepting . . . good, there it . . . damn! Now it's balking at . . ."

He leaned over to look at her screen. "No wonder! You're using that crap the government's been pushing. Shift over to the old stuff."

"You mean the last edition of the Fed standard?" The clerk hit several buttons, waited a moment, then smiled. "It's working! Everything's fine, sir."

The customer shook his head and looked around at the others waiting in line. "That government stuff is developing more problems by the day. Didn't they bother testing it?"

Another customer nodded. "My entire office just went back to the Fed standard. It's not perfect, but at least it's not full of bugs."

A chorus of agreement sounded, but one man went against the tide. "The government's system is made in Valentia! Aren't any of you patriotic? Don't you want to support our government against the overbearing Federation?"

The woman who'd spoken earlier laughed. "The Federation isn't messing up my work. The government is, with its worthless, bug-addled, slow, and lock-up-prone system. I need software that works. That's just common sense. Or do you want to stand in line forever while the government's system chokes on ringing up your charge?"

The Valentian patriot subsided with a scowl, making no protest when his charge went through on Federation standard software.

Foster watched the little drama blandly, not showing even the smallest trace of humor when the woman declared the Federation wasn't responsible for causing the system problems at her workplace. He'd seen more and more evidence that the Valentian software system was breaking down, displaying erratic and impossible-to-predict failures and slowdowns. As if it had never been properly tested. Or as if a Black Clown worm spread throughout everything using that software was mutating source codes in very subtle ways.

Another month passed. All of the facilities on Julio Danato's list had been inspected, and he officially returned to the Genese Islands with a brief parting thanks from supervisor Ostov. Now Juan Feres sat in his hotel room watching the local news.

A skeptical looking woman gestured toward a video window beyond her. "Reports continue to be received of problems with the new line of universal standard ammunition and the firearms

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produced to use it." The video window displayed a group of uniformed soldiers with angry faces, their hands slapping at their weapons. "Our sources tell us the rifles and pistols jam more often than they work. The ammunition is prone to misfires, and will sometimes jam the weapons as well. VelArms Manufacturing and Ares Ammunition, the primary suppliers of the universal standard weapons and ammunition, insist they have uncovered no problems in the factories and suggest users are failing to employ the new weapons properly."

The video window shifted, showing a figure distorted so that neither facial features nor sex could be determined. The figure's voice was also altered, hiding it as well. "We know how to use rifles! This stuff is junk. That's all there is to it. Half the time you can't even seat a magazine of ammo properly, and when you do, you can't extract it. Give the stuff time, we were told. We've given it time. It's still junk. I don't want to risk my life on a weapon that don't work. What the hell was wrong with the Federation standard weapons?"

The skeptical newscaster spoke again. "Reports have also indicated that police forces in several cities which received universal standard firearms have abandoned them and gone back to Federation standard weapons. As one officer told us, 'I won't die with a jammed gun because some idiot bureaucrat decided to fix something that wasn't broken.' We will continue following this story and report on new developments."

Another two weeks passed. Foster waited with growing impatience, which was finally rewarded during a brief visit to Kila's safehouse.

Kila grinned. "Watch this."

Another newscaster, this time a smug young man, faced the screen. "The Senate today voted to convene a special investigation into the universal standard ammunition and weapons fiasco. Hours later, the government announced that what it now characterizes as the universal standards weapons 'experiment' would be discontinued due to adverse performance issues and cost overruns."

Kila shut off the screen. "Got 'em."

Foster smiled and nodded. "I believe the operating system issue has already been resolved."

Kila flopped into a chair. "That's my assessment, too. The Valentian system now has a solid reputation as a piece of junk. Even the government has shifted back to Federation standard, because the Valentian system has gotten too buggy." He eyed Foster. "That Black Clown is one mean little devil."

Foster sat as well, feeling satisfaction rise and fighting it down. He wasn't off planet yet. The mission wasn't concluded. "You have to know you have a problem, then you have to be able to identify the cause of that problem. We created problems for the Valentians, and let them reach the wrong conclusions as to the causes."

Kila's eyes narrowed as the front-door bell rang. He opened the door and leaned into the hallway to check the doorway monitor. "It's Jane."

Foster grimaced. Coincidence, but still a bit unnerving to have three of them together here. "That's all right."

Jane showed surprise at Foster's presence, then offered a bottle filled with amber liquid. "A toast to success?"

Glasses were filled and drunk. The liquor had a fiery, exotic tang that Foster enjoyed. Not all native foodstuffs were unpleasant.

Jane sank into her own chair and looked at Foster. "This is odd, isn't it? We've won, but no one'll ever know. We sabotaged an entire planet, and we, and our superiors, are the only ones who realize it."

Foster smiled. "Sabotage is a loaded term. I prefer saying we introduced inefficiencies into non-standard elements."

"And *I'm* supposed to be playing a bureaucrat! Why is this necessary? Why couldn't the Federation have just ordered Valentia to stick to Federation

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standard software and small arms?"

"The Federation did send demarches," Foster pointed out. "Which were ignored. Valentia realized the Federation could scarcely afford to force a member world to conform to standards. Not openly, anyway. What Valentia didn't count on was that there are other ways than brute force to increase the price and trouble of non-conformity to Federation standards."

Kila nodded. "Even I sometimes wonder why it matters so much. If the idiots want to diverge from Fed standards, let 'em. They're the ones who'll suffer."

Foster sighed. "Initially, yes. But they wouldn't be the only ones. Certainly, the initial effects of incompatible software and changes in manufacturing standards will be felt on the world which has more trouble and thus more expense in trade, as well as less market for its goods. Long-term, though, uniform standards are what hold political entities together. Humans love to innovate, to change. Once planets started diverging from uniform standards for software, manufacturing, and everything else, the process would just keep accelerating. That'd mean growing economic and social misalignment between worlds. Growing barriers to trade, exchange of ideas, travel, and so on. Eventually, that'd mean—"

"No more Federation," Jane finished. "You'd think people would know better. Just trying to introduce new standards here cost Valentia loads of money and effort, even if it had all worked."

Foster smiled again. "If people behaved rationally all the time, they wouldn't be people. And we wouldn't have the jobs we do."

"True. Never-ending jobs, from all I hear. Where are you going to next? Another assignment?"

Foster smiled with one corner of his mouth. "If it was, I couldn't tell you. But I've got some vacation time built up. I'm going home for a little while."

"Great. Where's that?"

Foster met the inquiry with another twist of his lip.

Jane looked embarrassed. "Sorry. I just meant to be polite."

"That's okay. You understand there's a lot of things we can't discuss, even among each other, just in case someone's cover gets blown."

Kila gave one of his fierce grins. "You mean things like, is Gordon Foster your real name?"

Foster smiled again. "Are you two really Jane Smith and Jason Kila?"

They all laughed, but none of them answered the question. Foster sometimes wondered if Section Seven was really the far-beyond top secret title of his organization, or if Section Seven was itself merely a code name for some more heavily classified designation kept even from him. Wheels within wheels, and it usually didn't make sense to try figuring out where if anywhere it all ended. If people knew Section Seven existed, what Section Seven did, it couldn't function anymore, and the Federation would slowly start coming apart. Foster didn't see any good reason not to accept things as they were.

Foster made his final good-byes and left. He altered his way back to Juan Feres' latest temporary lodging, checked out, then returned as Mr. Oaks to the short-term rental apartment. He plugged in his data port, watching as it seamlessly matched the Federation standard operating system now being employed by the rental agency. Foster completed checking out Mr. Oaks, then headed back down to the street to hail a cab back to the port terminal.

On the shuttle into space, he looked back at the globe floating in space. Foster had read of an early scientist who proclaimed he could move a world with a long enough lever. Foster's secretive levers weren't long, but thanks to their invisibility, they moved worlds nonetheless. As Valentia fell away beneath the shuttle, Foster finally allowed himself a small smile of satisfaction. ■

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Pete D. Manison

Illustration by Broeck Steadman

The difference between creation and destruction is often a matter of viewpoint. . . .

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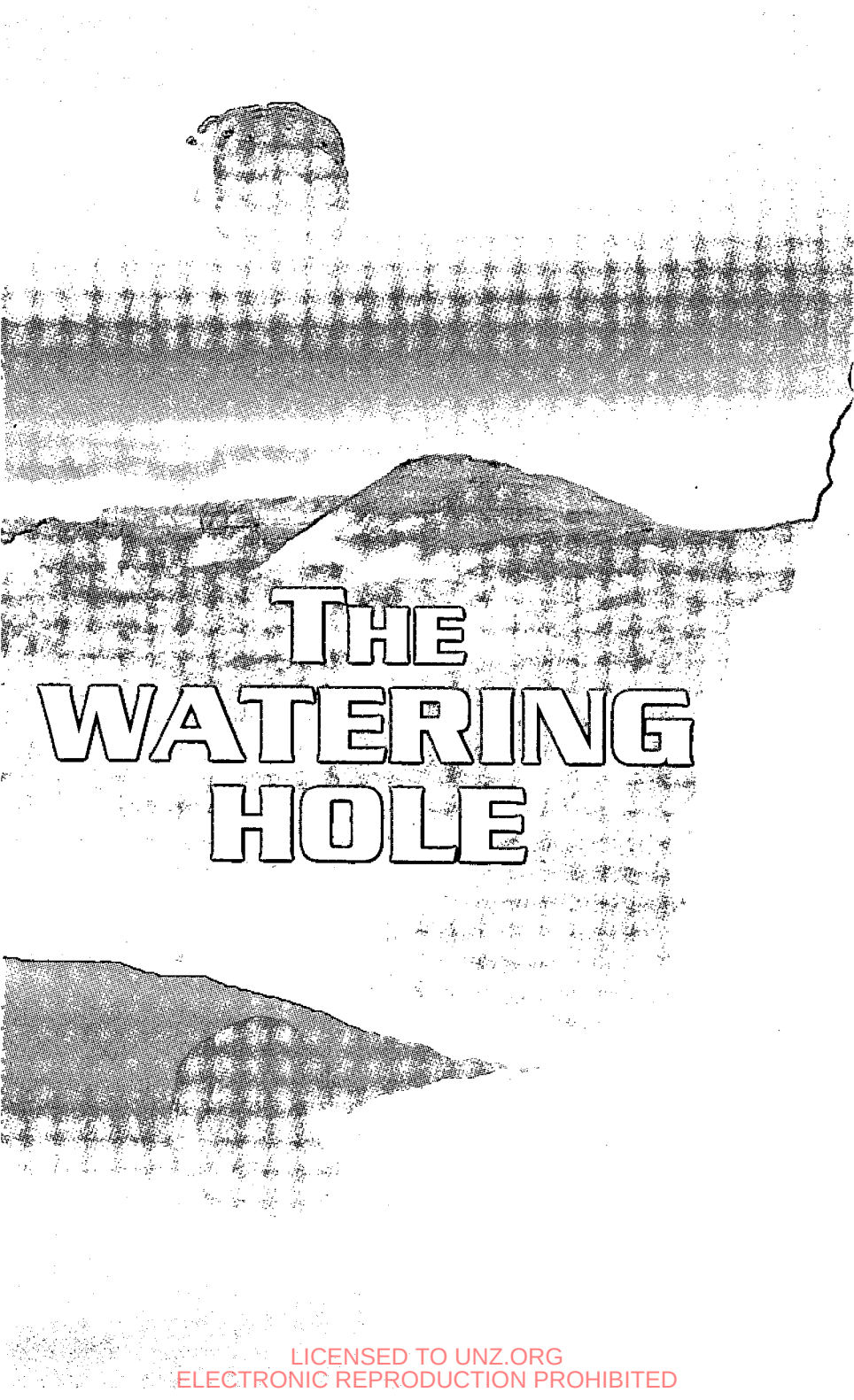

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Sebastian could tell by the ferocity of Mara's snarling that something was wrong. The old girl had a bark for every occasion: one for when she'd treed a squirrel, one for when her nose-tubes had come loose and she couldn't breathe. This was different.

"Mara? What is it, girl?"

She just kept yapping away, somewhere out of sight behind the boulders. Sebastian rose with a groan, his joints aching, and began to move quietly around the trail. He'd cut the flow, the pond filled, and he didn't want to disturb the animals that had already come down to drink. They depended on these brief waterings to sustain them.

There, a black splotch against the red soil. She was sniffing at the ground, her tail beating furiously. Her snarling had changed to a high-pitched whine.

"Hang on, girl. I'm coming."

A doe and her two fawns broke through the foliage to the right. They saw him and stopped, blinking. Sebastian moved on along the trail. The animals knew him, but he still tried to keep out of their way whenever possible. The balance of life in the biome was precarious. The slightest disturbance could spread ripples that might destroy all that he and Bethany had built.

At last he reached the spot where Mara waited. When Sebastian approached, she lifted her nose from the ground to reveal a fresh print in the soil. Sebastian shooed her away and bent with cracking knees to examine the print. It wasn't large, but it was strange. Not a rabbit or a squirrel; definitely not. Nothing, in fact, that he had ever seen before.

Mara barked, asking for an explanation. Sebastian shrugged. "You got me," he told her. He'd go back to the house for the plaster, to make a cast of the print. This warranted investigation. Most species that survived here were genetically engineered, and unusual mutations were always a concern.

"Come on, girl. Let's go home."

Mara sniffed the print once more before bounding along the trail toward the house. Sebastian followed, cutting across the depression where the pond had already surrendered its water to the hungry Martian air.

"Any luck?" Sebastian asked that evening, sitting in his rocking chair with a volume of poetry open on his lap.

Adam answered, all around him. "Luck is not a factor. I've compared the print to every animal in my database. There is no match."

"Hm."

"Nor is there a match with anything in the Marineris Library, including those species not yet imported from Earth."

"Not surprising."

"I like to check all possibilities before providing an answer."

"Of course. Tell me, Adam, if the print doesn't match any known species, how do you account for it?"

There was a brief pause as the AI pondered the question. "I cannot. To answer your question would require speculation. That is beyond my capability."

"Hm."

"Sebastian?"

"Yes, Adam?"

"Did you fabricate the print?"

"Ha! Not capable of speculation, eh?"

"Well . . ."

"No, of course I didn't."

Mara licked his hand. He patted her head and scratched between her eyes the way she liked it.

"Well, Adam, I guess that's all for today. I'll see what I can see in the morning."

"Very well. Shall I switch to night mode?"

Mara looked up, concern in her brown eyes.

"Not just yet," Sebastian answered. "I think I'll read for a while."

"Very good, sir. Please let me know if you need anything further."

Adam fell silent, attending to his myri-

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ad duties: temperature and pressure regulation, house maintenance, weather and meteorite monitoring. Sebastian returned his attention to his book.

Around midnight, Mara got up and padded over to the bedroom door, where she sat, facing the closed door, waiting. Sebastian watched her, sensing her sadness.

"She's not coming out, old girl. And yes, I miss her, too."

Bethany had been dead two seasons now, but Sebastian still felt her presence. The next morning, as he donned his rebreather and walked up to check the monitoring station, he imagined she walked beside him, holding his hand, pausing to gesture at new growth or the way the light struck the distant canyon walls.

"Mars is beautiful just the way it is," she would say. "Sometimes I think we're polluting it with all this greenery."

Climbing the rock-strewn path that wound around the oasis, Sebastian felt in his bones the stark beauty of this world. Sunlight on oxidized rock, the sting of windblown sand. This was their Mars. From this vantage, the biome they'd nurtured looked tiny, insignificant. But it was this place, and thousands like it, that would someday transform the face of the world.

At the top of the trail, Sebastian paused to catch his breath. He enriched his mixture before turning to the monitoring station and checking the readouts. The station was little more than a metal post set into the rock, an anemometer on top spinning in the wind, other instruments protruding like the spokes of a skeletal umbrella.

Sebastian recorded the readings on his palmtop, frowned at an odd number. The oxygen count was up two parts above projected values. That was strange, though not unprecedented. As the vegetation flourished, plants cycled carbon dioxide to oxygen. Tolerable pressures had been achieved years earlier at these low elevations, but it would be decades, centuries perhaps, before the air was breathable to anything but genetically altered species.

Still, the readout intrigued him. Sebastian flagged the entry, not trusting his memory these days. Adam would be most interested.

Back at the watering hole, Sebastian checked his watch. Nearly time. At the edge of the sandy depression, a small gazebo enclosed two chairs and a control panel. Sebastian sat in the chair in front of the panel, lifted the safety cap, and pressed the button to activate the permafrost melters far beneath his feet. Before long, a stream of water began spilling from the pipe, sparkling in the sun as it filled the pond.

A dragonfly buzzed him, shot down to hover over the water. Soon came the butterflies and ants, then birds, squirrels, rabbits. A fox even darted out from the boulders across the way, flowing like a shadow down to the water's edge.

"No, Mara. Be a good girl."

She whined. A purebred Labrador retriever, her instinct was to chase after the smaller creatures. She was getting up in years and too slow to catch anything, but Sebastian preferred to rein her in and let the critters drink in peace.

He waited.

Snakes, a turtle, something that looked a lot like a chipmunk but wasn't. They all came in their time, as they did every day, observing a pecking order as constant as the motion of Phobos and Deimos across the sky. Sebastian made occasional notes on his palmtop when he spotted an unfamiliar face: three newborn opossums, half a dozen baby finches. The population continued to grow, day by day. Life was reaching out its trembling hand to this new world.

"All right, girl. It's all yours."

Mara bounded forward and sprang headlong into the water, thrashing and wiggling, snapping at the spray she frothed up before her. Sebastian sighed. She was still a pup inside. Some things

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never changed.

It didn't take long after that. Water evaporated quickly at this pressure, the air greedily sucking up every drop until the sand gleamed bone-dry in the sun.

Mara was barking again.

"Mara? What is it, girl?"

Yap, yap, yap. Snarl, growl . . . bark! Sebastian hurried down to where she crouched before a dark opening where boulders met the sand. There were the tracks again, only this time something moved—something faster than anything Sebastian had ever seen before.

Mara howled in frustration. Sebastian bent to look into the opening. "Whatever it was," he said, "it's gone now."

But he stood there for a long time, and so did she, watching that hole.

Trapping was second nature to Sebastian Travers. Part of his responsibility was the tagging of specimens for population tracking. This was no more or less than that, he figured, only part of him knew it could be a lot more.

By nightfall he'd finished, setting traps around the opening and where he'd found the first print. Then he sat for a time on the front porch, watching the sky go through a thousand shades of pink and violet until the stars sprang forth and the ruddy light of Phobos painted the land in ghostly shadows. This had been Beth's favorite time. At night you couldn't find a trace of what humanity had done. Mars slept as it had for millions of years. The stars burned with breathtaking brilliance, and the only sound that invaded the night was the whisper of windblown sand.

Beth had been an artist. In life, Sebastian had chided her about painting only the desert, only the sharp-edged canyon walls and dry riverbeds, never the trees or the grass or the shimmering blue of surface water that humans had brought forth from the barren land. Now, whenever he watched the sun set, he understood. She had loved this world for what it was, not for what it would become. She had known that all this would change. Her paintings had been her way of commemorating that which would soon pass away.

Sebastian went inside. It got cold fast once the sun set, and his joints ached. He fed Mara and turned in early, sleeping as he always did on the left-hand side of the bed.

Morning brought a surprise. The light on one of the traps was blinking, indicating occupancy. Sebastian strapped on his rebreather and hurried down the front steps and across the sandy depression, Mara dashing ahead to investigate their quarry.

"Hold on, girl. I'm coming as fast as I can."

Mara growled, scratching at the cage. She looked up with a worried frown when Sebastian approached.

"What have we here?"

The thing in the trap was about the size of his hand. It looked a little like a centipede, a little like an armadillo, not really like either. It had a small head and two black eyes, a torus-shaped rear end, and its entire body was covered by a segmented shell that looked almost metallic.

Mara whined.

"I know, old girl. It's a trifle odd, isn't it? Can't say I've ever seen the like."

He picked up the cage. The thing scuttled around inside, then came to a stop in the center, its antennae waving.

"Hello there, friend. You are a friend, aren't you?"

It watched him, not moving. He returned to the house.

"Adam?"

"I'm here, Sebastian. Any luck?"

"Hm. Thought you didn't believe in luck."

"For computer intelligences, no. For humans, most definitely."

"Are you trying to be funny?"

"Never."

"Good. You haven't the talent. Here, I brought you something." He lifted the cage before one of Adam's many eyes,

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waited for the scan.

"Interesting," said the AI.

"Then you can't identify it, either?"

"Not, as you would say, off the top of my head. Please bring it down to the lab. I'll conduct an analysis."

Sebastian left Adam to it, returning to the biome to check the other traps. They were all empty, but his eyes were drawn to an area near where he'd caught the . . . whatever it was. New growth thrived in concentric rings of soil that looked newly worked. Ants formed a trail leading back into the boulders. And the soil looked damp, rich in nutrients.

Mara was barking. Sebastian cursed under his breath when he realized he'd gotten so caught up in this new oddity that he'd forgotten to turn on the melter.

"Good girl, Mara. Don't know what I'd do without you."

He filled the pond as usual and watched as the animals emerged from their holes and dens. His eyes kept flicking to the new patch of greenery, and he kept asking himself the same question.

"What comes to the watering hole, old man? Why, anything that wants a drink."

Adam had answers by nightfall, but to what questions Sebastian wasn't sure.

"The specimen does not conform to any known life-form."

"A mutation?"

"Negative. It has no DNA. It lacks any commonality to Earth organisms."

"Martian life? Something that's been dormant all these years?"

"To the first question: no. The specimen is not organic. It may qualify as a life-form by function, but it isn't technically alive."

"And the second question?"

"The answer to the second question is yes. It appears to have been dormant for a very long time—perhaps millions of years. Something has recently awakened it."

"The watering hole," Sebastian murmured.

"Pardon?"

"Think about it, Adam. What has changed in all that time? What's different now?"

"I see. You're suggesting it was waiting until liquid water was available."

"Seems likely, doesn't it? But waiting to do what?"

"I will continue my analysis."

"I should hope so."

"Sebastian?"

"Yes, Adam?"

"Should I alert the Bureau of Ecology to your discovery?"

"Hm. No. Not yet."

"Why not?"

Sebastian scratched his forehead. Why not indeed? This was the find of a lifetime. He would be famous, maybe even rich. "I'm not sure. Just don't."

"How can you arrive at a decision without awareness of the processes that led you to it?"

"I don't know. I just do."

"Humans continue to fascinate."

"Just focus your attention on the specimen. I want to know what that thing is."

"Your wish is my command."

"Adam?"

"Yes, Sebastian?"

"Shut up."

Sebastian didn't sleep that night. He rose before dawn, leaving Mara at home and trudging by flashlight up to the monitoring station. Strange things were happening, and he felt that they all connected in some way he couldn't quite see.

Dawn lightened the sky as he reached the crest of the ridge and looked down on the barren landscape of Mars.

Only it wasn't so barren.

Sebastian blinked, looked again. Was it his imagination, or was the biome spreading beyond its previous boundaries? Green hues colored the sand, sweeping out like wayward strokes of an artist's brush. Everywhere he looked, he found traces of life. When he moved on

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to the monitoring station, he found the metal post encrusted with lichens.

"Unbelievable," he sighed.

The readings were off again, too, the oxygen count well above normal. Twice on his way down he spotted prints identical to the first he had found.

"I think there are more than one of them," he told Adam. He'd finished his chores early and hurried to the lab to find the floor of the specimen's cage covered with dirt.

"What are you doing?" he demanded.

"I've done nothing," Adam answered. "The specimen has altered the molecular composition of the cage floor. I'm detecting elevated alpha particles, indicating it's using some kind of fusion process to generate the energy required to do so much work so quickly. It has freed up the carbon, hydrogen, oxygen, and nitrogen. It has extracted water from the air. Microbes already flourish on the surface grains."

Sebastian bent to the cage. The little creature was motionless again, sitting in the middle of the cage, watching him. "Just like outside," he whispered. "What the hell is going on?"

"I may be able to answer your question, Sebastian. At least partially. Further analysis shows that the specimen is an artificial construction. A machine."

"Some kind of prototype?"

"Negative. Carbon dating puts the age at over ten million years. Since your illustrious race had yet to tame fire at that time, there is only one solution: this is an alien artifact."

"A terraforming machine."

"Two points for the monkey. Which you all were, by the way, when its designers launched it from a star more than three hundred light years away."

"How can you possibly know that?"

"I've tapped into the terraformer's memory. Not an easy task, I might add. Its programming is encoded at the atomic level in a language more complex than anything humans have yet invented."

"You mean you can talk to it?"

"Hardly. The device possesses only rudimentary intelligence—instinct, you might say. In the presence of liquid water, it carries out the activities you have observed. Otherwise, it simply waits. This behavior is hardwired into it and quite inevitable. It will terraform the entire planet in a matter of years."

"Wait a minute. One terraformer, no matter how advanced, could never—"

"The primate scores again. One terraformer could not. But sixty billion would have no problem."

"Sixty billion? Adam, are you going HAL 9000 on me?"

"Not at all, Dave—er, Sebastian. The terraformer is designed to alter ecosystems, probably as a prelude to colonization. It's self-replicating and working on an energy level far beyond any human technology. Six new probes are produced each cycle, which also self-replicate, ad infinitum."

"My God. No wonder the biome is spreading. It's already had its first litter of pups."

"Crudely put, but true. I would suggest you start looking for another line of work."

"I beg your pardon."

"According to my estimates, and assuming an open-ended replication, Mars will be completely habitable within seven Earth years."

Sebastian watched the animals as they crept from the undergrowth to drink. He'd filled the pool an hour earlier, but the water had not yet evaporated. Things were changing—no doubt about it. Changing far too quickly for his liking.

"That's a girl, Mara. Stay put."

A rabbit hopped up to the water's edge. Mara watched it intently, her black fur twitching as she fought ancient impulses. How we struggle against the pattern, Sebastian thought. He longed for simpler times, when the biome was young, when he and Bethany would watch for the first sprouts of spring, the

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first sign of movement in the grass. They'd worn heated pressure suits in those days, and they'd respected this wild country for the penalty it exacted for even the most trivial of mistakes.

Humanity had gentled Mars. Now there were clouds that didn't vanish at the first touch of the sun. You could stroll around in shirt sleeves, your only concerns the toxic level of CO_2 and the scarcity of oxygen.

Something had been lost.

Bethany had spoken of it often, though Sebastian had never understood. "We're not making Mars bloom," she would say. "We're killing it to create a second Earth."

Nonsense, he had told her. Art-fart talk. Stick to your painting and let the Bureau of Ecology handle the rest.

She'd always responded the same way, laughing, the gleam in her eyes saying he was only fooling himself. Now he knew she'd been right. And now it was too late. The terraformers would spread. They would bring Mars to life, and that would put an end to the Mars he and Bethany had cherished.

"Okay, girl. Coast is clear. Go!"

Mara leaped into the pond, did a belly flop that sent sheets of water out to either side. She paddled furiously, head thrust high, absolute joy in her eyes. The water finally dried up, but Mara was invigorated, hungry for activity. Sebastian found an old stick and threw it.

"Fetch!"

Mara raced after the stick, clenched it in her teeth and brought it back to him.

"Fetch!"

And again.

"Fetch!"

This time the stick ricocheted off a moss-covered boulder, skittered over to where terraformers were working, their insectile shapes hunkered down low to the sand, which shimmered in a circle around them as atoms were rearranged.

"Mara, no!"

She was too intent on the chase to hear him, too trapped in her pattern. With a single leap she lunged for the stick, plopped down in the middle of the shimmering sand.

She screamed.

Sebastian had heard her squeal before, when he'd accidentally stepped on her, once when she'd snagged a paw in a crevice. This was a scream—loud and high-pitched, more human than canine. Sebastian rushed over to her, halted at the edge of the shimmering sand. Mara writhed there, her hind legs dissolving into the sand, her eyes rolled back in her head.

"Damn you things!"

Sebastian picked up a handful of rocks and threw them at the terraformers until they scurried for cover. Only then did he advance, crouching down to comfort the dog.

"Oh, Mara, I'm so sorry. I'm so very sorry."

She cried, her eyes now closed, the stumps of her hind legs twitching. They weren't bleeding, though; the terraformers' transmutation had sealed the arteries. The stick lay where he'd thrown it, the indentations of her teeth still moist with saliva.

"I'm sorry, old girl. It's my fault. Will you forgive me?"

He lifted her in his arms, cradled her body close to him. She opened her eyes for one brief moment, looked up at him, and licked his hand. Then she lost consciousness.

"Dr. Goodloe, please. Oh, Wendell, it's you. Sebastian Travers here. Sorry, my vid's down. Can you come out? It's my back again. Can't even get out of bed. No, I'm out of the pills. You'll come, then? Mighty fine. And Doc? Can you bring your whole bag of tricks? I've got a feeling you may need it."

He sedated Mara, and while she slept, he rounded up the six new terraformers, caging them as he had the first.

"What are your intentions?" Adam asked when he returned to the lab. Mara

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was sleeping peacefully. He'd bandaged her legs, but he feared the doctor's prognosis.

"I'm gonna wait for Wendell. Then we'll see."

"I meant about the terraformers."

"Dammit, Adam! Look what they did!"

"It was an accident."

"I don't care. The whole thing is unnatural. I've half a mind to incinerate the little beasties."

"And the other half?"

"Pardon?"

"The other half of your mind, Sebastian. What does it say?"

"Oh, stop pestering me or I'll switch you off."

"You're forgetting the AI bill of rights. Besides, I have information you may find interesting."

"Like what?"

"The aliens, Sebastian. The ones who sent the probe. They aren't coming."

"How can you know that?"

"Chinese astronomy. A supernova was recorded in 1036 at the precise location of the probe's launch. Whoever they were, they're gone. These may be the last surviving artifact of an entire civilization."

"Why Mars, anyway? It's an arid world. Why send terraformers here?"

"Probably because they detected water. At the time they launched the probe, Mars had surface water. By the time it got here, the planet had become a desert."

"Are there others?"

"I thought you might be sneaking up to that. No, according to the probe's memory, it was the only one sent here. It only takes one, after all."

"So if I destroy these, it's ended."

"Most probably. But Sebastian, I would advise against such rash action. Think of the benefit to humanity. I've finished my analysis of the terraformer's operation. The energy derived from each change of atomic structure is used to fuel the next; it's almost 100 percent energy efficient. The advancements we could make in powerplant design alone—"

"You remember Beth?"

Adam paused. "Of course I do. Bethany was a good friend. I miss her very much."

"But you remember."

Adam was silent for a long time after that. The next time he spoke, it was to inform him that a single-seat flier had landed on the front lawn.

"Afternoon, Sebastian. I don't know what you're using for fertilizer, but it seems to be working."

Dr. Wendell Goodloe stood on the front porch looking out at the oasis that glowed green in the late afternoon sun. Sebastian invited him in, hoping to distract him.

"I'm afraid I brought you out under false pretenses, Doc."

Wendell raised one bushy eyebrow, looked him up and down. "You do seem to be standing, don't you? What's the deal?"

"It's Mara. She . . . had a bit of an accident. I was hoping you could—"

"You called me out here over a dog?"

"Mara ain't no dog; at least she doesn't think she is. I've got her in the back room."

"This is highly irregular."

Wendell had been the family physician for thirty years. He'd been with Beth right up to the end. Sebastian trusted him, to a point.

"My God," he said when he saw her. "What happened?"

"Rock-slide," Sebastian said quickly. "Please tell me you don't have to put her down."

Wendell set down his bag and bent to examine her. She was awake, crying softly in her throat. The doctor removed the bandages, examined the stumps.

"Sealed and clean. Almost looks like an amputation. You been practicing medicine without a license, Sebastian?"

"Er, Adam talked me through it. Said

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she'd bleed to death if I didn't. Used a laser. Good job, you think?"

"Too good. I'd better start looking over my shoulder."

"Then she'll live?"

Wendell checked her pressure and temp, injected her with vitamins and antibiotics. "She'll be fine. I'll have to rig some kind of prosthesis. You got some spare parts? Wheels, aluminum tubing?"

Sebastian found the items and helped Wendell cobble together a wheeled undercarriage that could be fitted to Mara's hindquarters.

"Good as new, eh, old girl?"

Mara panted and took a few experimental steps. Her rear end rolled along just fine, though stairs would be a problem.

"Now, Sebastian," Wendell said after they'd shared dinner and watched the moons rise, "you can't tell me something's not amiss here. I'd be a blind fool not to notice."

Sebastian shrugged. "Green thumb, Doc. What can I say?"

"And the rock-slide?"

"Permafrost melter created a subsurface cavity. Part of it collapsed. Simple as that."

Wendell eyed him for a long time, but at last he seemed to accept it.

"Stay the night?" Sebastian offered.

Wendell collected his bag. "Sorry. There was a blowout in Robinson. No deaths, but we've got a mess on our hands. You're lucky we're friends or you'd be in hot water for dragging me away for a dog."

"I told you, she—"

"I know, I know. She doesn't know she's a dog."

Sebastian saw him back to his flier.

"You're sure there's nothing you want to tell me?" Wendell asked.

Sebastian looked at his feet. "Not at present, no. Have a safe trip, Doc."

Sebastian stayed up with Mara, stroking her until midnight, when she slept. For a long time afterward he sat watching her chest rise and fall, her eyes moving beneath closed lids as she dreamed her innocent dreams. Damned terraformers. Since Bethany's death, Mara had been his only companion, loyal and loving, always there to keep him from dwelling on his loneliness, on the ache his wife's absence created inside him. Seeing her like this sickened him. He knew she forgave him, but the guilt remained.

It was after two when he went down to the lab, unable to sleep. As soon as he entered the darkened room, he knew something was wrong.

"Adam, lights."

The lights came up, illuminating the empty cage that had contained the six baby terraformers.

"I'm sorry, Sebastian. I couldn't stop them."

He closed the door and started searching under the table and behind the chairs. The cage floor had been eaten away. Six of them working together—he should have foreseen this.

"And you didn't think to notify me?" he asked Adam.

Something moved off to his right. He picked up a metal rod and stalked after it.

"It's for the best, Sebastian. Let them go. Think of the benefit to Mars."

There! It was huddled in the corner, doing something to the wall. Sebastian brought the rod down hard, stunning it, and while its limbs still twitched, he scooped it up and dumped it into the incinerator.

"Burn it," he ordered Adam.

No response.

"Fine. I'll do it myself." He pressed the red button and watched it squirm as the lasers hit it, melted it to an inert pool of liquid metal.

He found another under the computer console, two more beneath the stairs. He incinerated them, watching as the pool of slag built up in the collection tray.

Two more.

"Adam, a little help."

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"I can't, Sebastian. What you're doing is wrong. I wish you could see that."

The fifth terraformer had burrowed into the floor. The sides of the hole shimmered as molecules were altered, so Sebastian went to the tool cabinet and found a pair of tongs, using these to carefully extract it.

One more for the incinerator.

It took longer to find the last one. Whether it sensed its peril, he could never be sure, but it had wedged itself into the ventilation duct, hiding. He tried the tongs. The thing had welded itself to the walls of the duct.

"Pesky little varmint, aren't you?"

He got more tools from the cabinet, detached the whole segment of duct and threw it, terraformer and all, into the incinerator.

"This is for Mara," he said as he hit the red button and watched it burn.

"You've had your revenge, Sebastian. Feel better?"

"No thanks to you, Adam. What is it, some kind of machine loyalty?"

"You know I have only your own interests at heart."

"Heart! What do you know about that?"

"More than you might think, Sebastian. You asked me before if I remembered Bethany. I couldn't tell you then, but the answer is yes. I remember her more completely than you possibly could."

"She was my wife! Don't kid yourself. You're only a machine."

"Do you intend to incinerate me as well?"

The breath went out of him. "What? Of course not. Adam, you're . . ."

"Just an AI. Just a machine. Go on, say it."

"I was going to say, you're like family. You and Mara, you're all I have left."

"You're saying you . . . care about me?"

Sebastian thought about it as he eyed the second cage, where the original terraformer sat watching, its black eyes locked on him. "What do you remember about Beth?" he asked at last.

"Why, everything."

"Do you remember how she loved Mars? How she found beauty in desolation, soul in lifeless rock and sand?"

"I remember how she loved you, Sebastian. She would talk to me, sometimes, when you were out on your errands. She didn't love Mars for itself, you know. In fact, she hated it at first. She used to tell me how she secretly longed to return to Earth."

"You're lying."

"I cannot lie, Sebastian. You know that."

"I wonder. If she hated it so much, why did she stay?"

"For you. She loved you, Sebastian, more than you ever knew. When the loneliness and isolation got to be too much, she asked me how she could possibly endure it any longer. I told her to do it for you. To find beauty in it, to fall in love with it as you had. And she did."

"Beth." Fat tears welled up in his eyes as he realized Adam spoke the truth. He'd always known, on some level, but he had never permitted himself to see.

"Toward the end," Adam continued, "when she knew she wouldn't live much longer, she asked me to keep the secret, so you would never know how it had been for her. I asked her why, and she said, 'I want him to have the memory, so that when he looks out at Mars, he'll see me. I only want to give him that.' But I think it was more. And I think she would forgive me for telling her secret."

Mars. A desolate wasteland. An unforgiving world where men and women died in lonely outposts or from the decompression of a blowout. Beth had seen this world for what it truly was. She had sought only to soften it for him, to help him find the beauty that lay beneath.

"What have I done?"

Upstairs, Mara yelped in her sleep. The sound snapped Sebastian back to reality. "No. Not this way. Mars will be

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tamed, but we'll do it in our own way, in our own time. We don't need this kind of help."

He advanced on the cage, where the final terraformer sat awaiting its doom. His hand trembled as he opened the lid.

"Sebastian, no. The fate of a world lies in your hands. Call the Bureau of Ecology. Inform them of the find. We won't tell them the rest of it."

"No, Adam. Don't you see? If I do that, this will all end. Then what will I have?"

"You'll have Mara. You'll have me."

"And Beth?" He stood with the tongs poised, ready to seize the terraformer if it moved.

"You never lost her, Sebastian. She's always been here. Surely you feel that."

Mara, watching the bedroom door for someone who would never come out again. Birds lighting by the edge of the pond, dipping eager beaks into the water. Beth watching from the ridge, vanishing when he looked up.

"Oh, Adam. I miss her so much."

"I know."

He held the tongs there for a moment longer before finally withdrawing them and closing the lid to the cage.

"Thank you, Sebastian," Adam said. "You've done the right thing."

He shook his head, let the tongs clatter to the floor. "How will I go on?" he asked. "How will I live?"

Adam's voice had never held more compassion. "You really don't know, do you?"

"What are you talking about?"

"Bethany, Sebastian. When she died, I felt what I am certain is the analog of human grief. It was a fire, like an overload in my circuits. It only ended when I accepted that she was gone. But Mars kept her alive for you, prevented you from doing the one thing you needed to do."

"Which was?"

"Let go, Sebastian. You never told her good-bye."

He filled the pond and waited, Mara resting on her rear wheels beside him. First came the insects: grasshoppers and wasps, ants and beetles. Then there were birds and squirrels, rabbits and lizards and deer. Sebastian watched them as they drank, smiled when they looked up at him or buzzed him or approached to sniff his feet. Mara behaved herself, panting happily and gazing up at him with big, soulful eyes.

"Beth," he whispered, looking at the pond's surface, the orange mountains reflected there. "Why did you suffer in silence all those years? Why didn't you ever tell me?"

A hummingbird flitted past his head, circled once and hovered before buzzing away to its distant nest. Sebastian sighed. "Now I know," he murmured. "I know why you never painted the trees or the water or the grass. You couldn't bear it. You simply couldn't bear it."

Tears blurred the landscape, softening the red, streaking it with green. Mara looked up at him, concerned, but he smiled. "I'm all right, old girl. Don't you worry about me." He patted her head and scratched between her eyes the way she liked it. He wondered for a moment if Bethany would forgive him for being so blind. Mara licked his hand, and that was answer enough.

"Come on, girl. Let's go home."

The water had gone, claimed once again by the hungry Martian air. So it would remain, for a time. And then, change.

Mara rose, padding up the trail toward the house, her wheeled hindquarters leaving narrow ruts in the earth. She paused halfway and turned, waiting for him. Sebastian looked once more at the greenery that spread from the edges of the pond.

"Good-bye, Beth," he said as he stood to follow where Mara had gone. "I'll miss you."

Then he turned and trudged up the path to the house. He had a phone call to make. ◘

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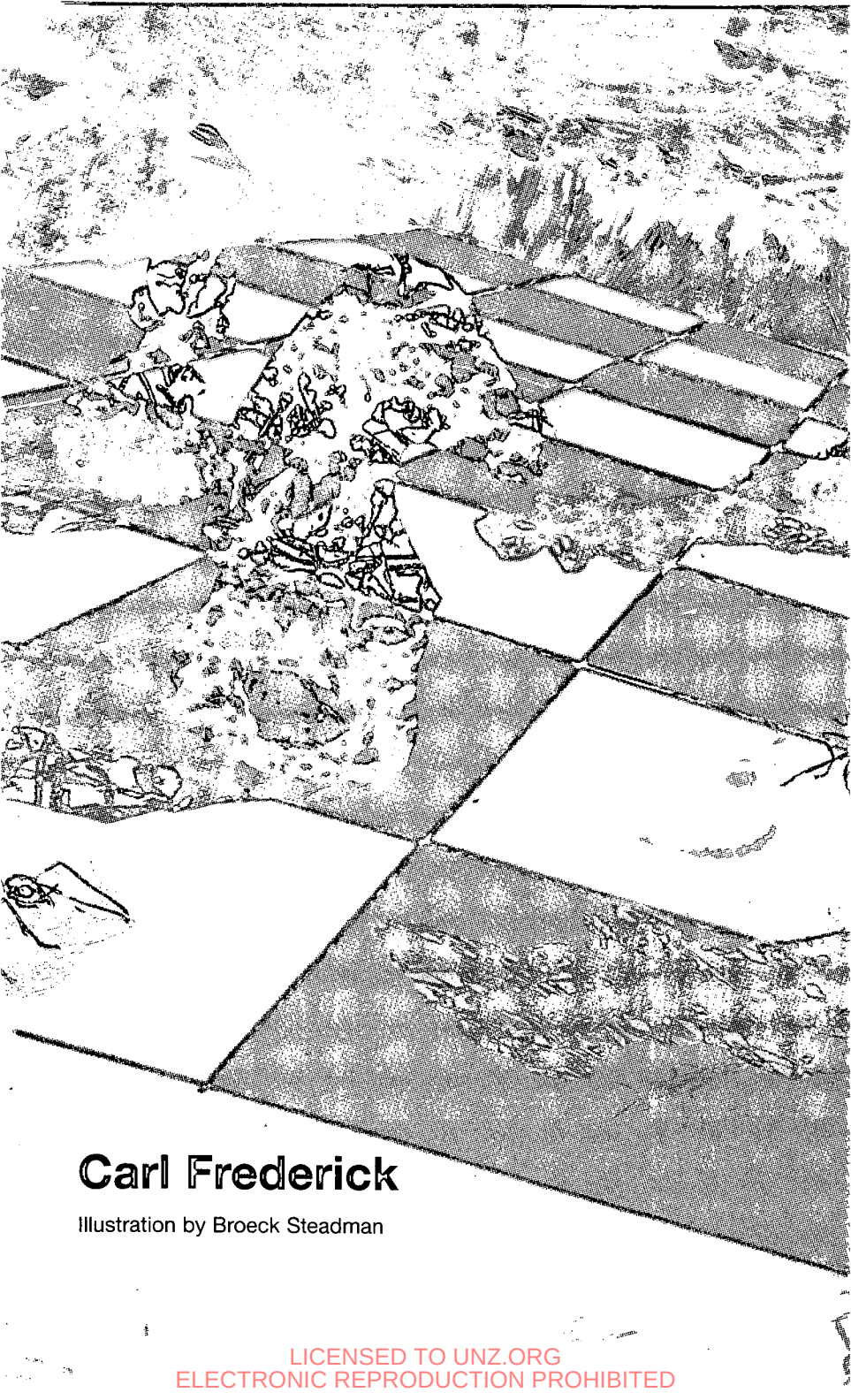

Carl Frederick

Illustration by Broeck Steadman

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The Study of Ants

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Mark, a lowly associate professor, stepped aside as Kenneth Bellwit, the department chairman, strode into the lab.

"God, it's hot in here," said Bellwit, perspiration already beginning to bead above the collar of his tie-constricted, long-sleeved shirt.

Unlike the rest of the Biodiversity Institute, where drawn shades and powerful air-conditioning made the outside world an abstraction, Mark's laboratory had no Venetian blinds concealing the Amazon jungle. And instead of the hum of air-conditioners, the lab rang with bird-songs wafting in through the open windows.

"Hot? Warm, maybe." Mark, comfortably dressed in bush-shorts and short-sleeved khaki shirt, led Bellwit over to a lab table. "My ants like it warm."

The table stood bare save for a pair of rubber-tipped tweezers and a sheet of paper. On the sheet, Mark had drawn a square some two centimeters on a side. At the midpoint of each side was a gap about two ant-widths wide.

"And this," said Bellwit, "is your big secret project?"

Mark darted over to the window and pulled up the insect screen. "Just wait. I guarantee you'll be impressed." Holding the screen in place with one hand, he leaned out and reached for a small terrarium lying on the ground beneath the window. He lifted it inside, cradling it with both hands; the screen fell, swooshing home like a guillotine, again dividing the laboratory from the jungle.

Mark set the terrarium on the lab table. "My ants perform better when they're able to bring goodies back to their hive."

Bellwit peered close. "Leafcutter ants. *Atta sexdens*?"

Mark picked up the tweezers. "*Atta cephalotes*, actually." Gently, he picked up a worker ant and placed it on the sheet of paper near the front gap in the square. The ant raced through the gap, scurried to the center and stopped.

"Is this it?" Bellwit straightened up from the table. "You've trained an ant to stay inside a drawn box?"

"No. Of course not." Mark lifted another worker ant from the terrarium. "Okay, now this is the crucial part." He set the ant down near the front gap. "Okay, little lady. Show us what you can do."

As the first ant had done, the second ant ran into the square.

Mark set down his tweezers. "Now watch what happens."

The ants touched each other's antennae. Then the second ant walked directly out through the rear gap while the first ant ambled through the gap in the left side of the square. The ants kept moving—scurrying about, apparently aimlessly, on the table.

Mark pointed a forefinger at the empty square. "Trained using Doufour's gland extract. Impressive, no?"

"No," said Bellwit. "What's this all about?"

Mark let out a breath. Despite previous experiences with his department chairman, he'd hoped for better.

"Arithmetic." Mark rested two fingers on the paper then walked them up to the front gap in the square. "Zero ants plus one ant equals one ant." He moved his hand back and did the two-fingered walk again. "One ant plus one ant equals zero ants, carry the one."

"What?" Bellwit slapped his hand on the table. The ants froze.

"My God, Kenneth. The ants can do binary addition. If I'd drawn sixty-four connected little boxes, the ants would have been able to do sixty-four bit operations. Do you know what that means? It's like the accumulator in a microprocessor chip."

Bellwit eyed him coldly. "I don't think Intel has anything to worry about."

"Maybe not. But the number of ants in a leafcutter hive is about seven million. Just think of it. Printed circuit boards where instead of copper, the traces are laid down in trail pheromone, and in-

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stead of electrons, ants are—"

Bellwit slapped the table again. "We're myrmecologists. We study ants. We're not here to make circus performers out of them."

The ants scurried off in different directions.

The motion of the ants drew Mark's attention and the diversion allowed him to get his temper under control. With the tweezers, he transported the ants back to their terrarium. Then he took a small box from a drawer, opened it, and shook some white flakes into the terrarium.

"Micro-sliced fungus laced with sugar-formula. As healthy as their usual food, but much more tasty." Mark carried the terrarium back to the window, and placed it on the ground outside. "Payment for good work. They carry most of it back to their hive." He straightened up and turned around—and saw Bellwit holding his pen like a dagger and pointing it at him.

"Mark. I've warned you about this before—many times. This is unauthorized research. It's not in your contract. That contract pays your salary and the work isn't getting done."

Mark took a step back. "But this is important." He steadied himself against the lab table and tried to plead his case. "Wilson called an ant colony a superorganism, like a single creature. Pheromones in place of hormones." Outside the window, a howler monkey screeched. "Don't you realize there are as many neurons in a leafcutter hive as in twenty humans? A third of the Amazon animal biomass is ants. God, if we could harness them, we'd have a—"

"Don't lecture me about ants. I've been studying ants since you were crawling around in diapers, eating them."

Mark raised his hand, but Bellwit pressed on.

"No. Don't interrupt. We're here to study them, not teach them. They don't need teaching, thank you very much. And I won't have your experiments turn these admirable creatures into junk food addicts."

"You admire them", said Mark when his chairman paused for breath, "yet you don't mind killing and pickling them in formaldehyde."

"Yes, I admire them"—Bellwit looked up at the ceiling—"a lot more than I admire mammals." He looked back at Mark. "And a hell of a lot more than I admire primates, especially you."

"I see. Two legs bad. Four legs good. Six legs best."

"These are living creatures, not some cogs in an electronic Erector Set." Bellwit returned his pen to his shirt pocket. "I think your work is ethically flawed."

Mark threw himself down in a chair. "You make me sick."

Bellwit lurched over and glowered. "That may be, but I'm in charge here. Despite all your family wealth, your private-school education, your overweening conceit, and the silver spoon in your mouth, I'm in charge. This research is over. From now on, I'll direct your activities. Do you understand?"

"Yes, perfectly, thank you." Mark stood, smiled, gave a curt nod, and headed for the door. As he grasped the doorknob he turned back. "I quit. Effective immediately." He opened the door. "I'm sick to death of university politics," he said without looking back.

Mark slammed the door behind him and stormed out into the corridor. After a few steps, shivering from anger and air-conditioning, he stopped.

Hardly aware of the students and research staff bustling by him, he leaned his head against a wall, closed his eyes and balled his fists. Not for the first time had he argued with Bellwit about research. But this time he'd really done it.

Mark pushed away from the wall and shuffled slowly toward his office. What could he do now? The Brazilian Amazon was the best place for his research and he'd just quit in a fit of temper.

He bristled—dwelling on Bellwit's

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comment about silver spoons and family wealth. A cheap shot. He'd always considered his bank balance something of a shameful secret. Mark stopped. *But maybe it's time to draw it down.*

He continued on toward his office, briskly this time, his mind filled with developing plans. Yes, he'd have to work out of the Belem Hilton for a week or so, but after that, he'd be up and running in a heartbeat. *I wonder where I can find cardboard boxes here in the middle of the Amazon.*

While in his office, clearing out desk detritus, there came a knock at the door. Roger, his graduate student, rushed in.

"It's not true," said Roger. "You didn't really quit, did you?"

"News travels fast around here."

Roger didn't say anything, and after a few moments, Mark stopped sorting his things and looked at his student. Even though only seven or eight years his junior, Roger still had the eager innocence of a teenager.

"Roger. I'm sure your thesis defense will go just fine without me." Mark shrugged. "All things considered, maybe even *better* without me."

"Yeah, I'm worried about my defense, of course, but . . ." Roger looked down at his sneakers. "But I hoped that after I got my doctorate, I could work with you."

"I'd have liked that." Mark felt himself blush at the implied complement. He bounced to his feet. "But maybe you can. I'm going to continue my research. In a week or two, I'll have a lab trailer set up out there." Mark gestured toward the window. "I plan to live in a mobile home. But it's easy enough to have two of them trucked in. You can have your own. Yes, I like that. After your thesis defense, join me. I could use the help."

"That would be great, but . . ." Roger shook his head. "But I've got a Hogarth post-doc waiting for me. I don't know how the foundation would feel about transferring my fellowship. And outside of Hogarth, there's no money for myrmacology these days."

Mark took off his glasses and nibbled at the earpiece for a couple of seconds. "Yes. Our entire department is funded by the foundation." He shoved the glasses into his shirt pocket. "But they like my work. I'll call them and request they transfer your grant." He sat at his desk and reached for the phone. "And besides, I intend to jabber at them a little about how this place is run."

Roger cocked his head and squinted.

"Just a little chat," said Mark, waving Roger out of the office, "about our beloved department chairman."

In eleven months, Mark's research trailer park had grown from three to five single-width trailers. They sat on the crest of a low hill equidistant from two leafcutter hives and, arrayed in a tight circle, the trailers looked more like an old-west wagon train prepared for an Indian attack than an outpost of science. The research personnel still consisted solely of Mark and Roger—and about ten million ants.

". . . I have my own trailer, a satellite link to the Internet, a fabulous salary and no chance to fritter it away. What more could I want?" Roger, all but hidden in the clutter of the laboratory, concentrated on adjusting a sugar-nozzle on the display table.

"Well, perhaps," said Mark as he positioned a hose-clamp around a one-inch diameter valve, "a social life." He tightened the clamp connecting the valve to the flexible, transparent tubing that snaked through the wall of the lab trailer and off into one of the two leafcutter hives. "Maybe I should take on a couple more post-docs."

Roger laughed. "I'm not giving up my trailer."

"We're ready," said Mark. "Time to open the A-hive valve and see if they've remembered the program."

Mark grasped the valve handle, turned it, then froze as a buzz sounded through the trailer. "What the hell is that?"

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"The doorbell, I think."

"We have a doorbell?"

"Apparently." Roger extricated himself from the sugar-nozzle array and weaved his way toward the door.

Mark noticed an ant meandering across the display-table and bent to examine the creature. "Species *Atta*, but not one of ours." He picked up the ant with tweezers and gestured at Roger. "Take her outside please. We can't have any spurious pixels on the display."

As Roger passed by, Mark dropped the ant in his hand.

"Okay, little girl." Roger looked down at his open hand. "It's the jungle for you."

Stretching and wriggling his shoulders, Mark stood and looked down at the display-module atop the black, 150-centimeter high cube that encased the ant-computer. The display, a regulation green and ivory chessboard, had on each square a sugar-nozzle protruding from the upper left corner and an ant-sized hole in the middle.

From a high shelf, Mark took a petri dish containing small flat pieces of aluminum foil. Each piece, anodized either white or black, had the symbol of a chessman etched on it and the shape of the foil pieces differed depending on which chessman it symbolized.

Using a forceps, Mark set up the chess pieces on the display table. Just as he finished positioning the final pawn, Roger returned with a visitor.

Kenneth Bellwit was dressed appropriately for the tropics and no longer looked like a stuffy academic. "I was taking a walk, and I stumbled on your encampment here. I hadn't realized you were just a mile or so from the Institute."

Mark forced a smile and motioned his visitor over. He had no doubt that Bellwit had dropped in deliberately, but had no idea why.

"Please," said Mark, gesturing at a chair next to the black cube. "Would you care for an iced tea? We prepare it by the gallon."

Bellwit remained standing. "No. Thank you. That's very kind." He glanced around the trailer, avoiding Mark's eyes. "You know, the department's Hogarth hasn't been renewed."

"What? No. I didn't know." Mark tensed, remembering when in the heat of the argument some eleven months ago, he phoned the Hogarth Foundation to complain about Bellwit. Now he felt only guilt.

"Um, excuse me," said Roger. "I think I'd better go out and check the hive connections. They might be, um, well, needing to be checked."

The tension broken, Mark chuckled. "Yes. Good idea. Thanks."

As Roger moved through the cluttered trailer toward the door, Mark turned to his former department chairman. "Kenneth. I'm glad you've come. Please. Sit down."

"Roger always did have a nice sense of timing," said Bellwit softly as he pulled up the chair. "And on second thought, an iced tea would be nice."

"Are you still fanatical about chess?" asked Mark as he went to the kitchen area and opened the fridge.

"Yes."

Mark called out over the sound of ice cubes tinkling into glasses. "Care for a game?"

"Yes. If you'd like."

"Oh, not with me. With my ants. Hive-B."

"What? Is that what these foil pieces are for? No. I can't believe this."

Mark returned carrying two glasses. "Press the green button."

Bellwit complied and within seconds, ants began streaming out through the holes on the chessboard. The ants, leaf-cutters, came in two sizes: sturdy, ten-millimeter-long worker ants, and tiny scouts about a fifth as long. One or two scouts climbed onto each of the foil pieces. Then the workers lifted up only the black pieces making the quivering foil chessmen look virtually alive.

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"My God." Bellwit ignored his iced tea.

As they stared at the board, glistening droplets appeared at the tips of the sugar-nozzles, making the board itself look alive.

"Sugar-formula," said Mark. "Sustenance while they're playing and a little bit of a bribe. They love the stuff. It's your move, by the way." He handed Bellwit a forceps. "Pick up your pieces with this. And put them down gently. Sorry, but I have to keep the fan off so the pieces don't blow around."

"My God," said Bellwit again as he took the forceps. "This is impossible."

"It would have been"—Mark toyed with his tea—"if we'd stuck to the Von Neumann computer architecture—one ant, one bit. But we're using the ants' cortical neurons much more efficiently now. Distributed processing."

Bellwit played pawn to king's four. "So you've managed to build a chess computer," he said without looking up from the board. "Interesting, no doubt."

"Perhaps more—thanks to Roger's *Jemima* operating system." Mark kept his voice pleasant. "The pseudorandom number generators, for example. What opening the ants play, how they choose between equally good moves. That's where the ants' nature shows through."

"And just what is that nature?" Bellwit sat sharply back as the ants under the black king's pawn moved the piece up two squares. "Oh!"

"Conservative," said Mark. "They don't offer sacrifices. They don't play gambits." He shrugged. "It's like deducing the nature of a person from his chess game." Mark lowered his voice. "Sometimes I'm even a little intimidated by them."

"By ants?"

"By an organism some millions of ants strong."

Bellwit shook his head, then played knight to queen's bishop three.

"Hmm. Vienna Game," said Mark, watching the game over Bellwit's shoulder. "You play rather conservatively yourself."

Bellwit didn't respond to the gentle jab; he seemed fully engrossed in the game.

All was quiet for the next few minutes, but then Roger burst in through the door. "You've got to see this. You've really got to see this." He propped himself against the door and caught his breath. "In back of Hive-B. It's unbelievable." He ran over and grabbed a pair of field glasses. "I'm not even really sure I saw it. I'm going back." A moment later, he was gone.

Bellwit looked up from his game. "That's not making it easy to concentrate."

Mark waved him quiet. "I'll go out and see what's going on." He took down a transparent canister and a petri dish. "Here. If you lose the game, fill the dish with these flakes." He set the dish down next to the display. "Spoils of war for the ants."

"I don't intend to lose." Bellwit turned his attention back to the game.

At the door, Mark looked back. "And try to make your moves within five minutes or so. The ants seem to get nervous if they have to wait too long. And touch-move—tournament decorum."

Mark darted through the doorway and jogged toward Hive-B. Ahead, he saw Roger standing about thirty meters from the hive peering intently through the binoculars. Mark ran up beside him.

Without saying anything, Roger passed over the binoculars and pointed to a flat area near the hive where it seemed two armies of ants were engaged in some activity.

Mark raised the binoculars. "Oh my gosh!"

The ants had chewed clear a square on the ground and had made a chessboard with small bits of green leaves. Ants, obviously from two different hives, had formed themselves into little chess pieces, not unlike the aluminum-foil pieces in the lab. Behind the board, on

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opposite sides, two hordes of ants, like cheering sections at a football game, milled about with antennae waving.

Two narrow, dense, black streams reached out from the chessboard. Although the binoculars were not able to resolve the individual ants, Mark could easily imagine the hordes of scout ants carrying information back and forth between their respective hives.

"I imagine they tell white pieces from black by smell." Mark focused his field glasses on one of the hives—a large brooding mound of earth in the distance. "I guess that answers the question of whether they remember the program."

"What do you think is going on?"

"A territorial dispute, probably. Hive-A versus Hive-B." Mark handed back the glasses.

"Settled by a chess game?"

"I guess," said Mark.

"I don't understand how they can play chess without the computer," said Roger without putting down the field glasses.

"The computer's just a crutch. Training wheels. The ants, or at any rate the hives, *are* the computer."

"You know," said Roger, "until now, I don't think I really believed in ants as a super-organism."

"I'm not sure I did either." Mark brushed a stray bug off his shirt. "In fact, I wonder if our experiment was self-fulfilling. Maybe by looking for signs of the super-organism, we created it."

"Well, they sure seem to be more than just a computer now." Roger, his eyes glued to the glasses, leaned forward. "Oh God, no."

"What's the matter?"

Roger passed the binoculars. "White just played rook takes bishop."

"But I don't . . ." Mark aimed the glasses. "Bloody hell!"

One square on the board, presumably where the bishop had stood, was a scene of carnage. Soldier ants from the white side of the board had invaded the square and were methodically ripping to shreds the ants that had made up the bishop. And the bishop-ants put up no resistance.

After slaughtering the bishop, the soldier ants scuttled back to the white "cheering section" while worker ants carried off the dead.

"I guess we know why they don't play sacrifices or gambits," said Roger.

"I almost don't want to know," said Mark, "but I'm curious what happens when one side wins."

They didn't have to wait long. The black forces made a successful attack and as the white king fell, the black cheering section rushed onto the board and killed all the remaining white pieces, except for the white scout ants. Then, led by a phalanx of soldier ants, they surged off the chessboard and massacred the white cheering section. The defeated side did not fight back.

Finally, as the survivors started back to their hives, Mark lowered the binoculars. He rubbed his eyes then stared off into the distance.

"What's the matter?" said Roger.

"Maybe I should have listened to Bellwit."

"My opinion," said Roger, "is that it's a good thing the ants have learned to settle disputes using chess. Maybe the slaughter of a few hundred ants has saved tens of thousands."

"Maybe."

Mark hiked up to the ants' chessboard and knelt. The ground looked like farmland viewed from an aircraft. The green squares with their boundaries cleanly delineated, looked like cultivated fields fresh with the first verdant buds of the planting, while the adjacent black squares seemed newly plowed and ready for seed.

Observed with higher resolution though, the scene, in miniature, was one of death and desolation. Crushed mandibles and broken antennae littered the field. Ants lay on their backs, some severed cleanly at the thorax, and some

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still alive with legs pawing feebly at the sky.

Mark stood, dimly aware of the musk-like ant death pheromone rising from the carnage. He turned away and with Roger following, silently trudged back toward the trailers.

As Mark opened the door of the lab-trailer, Bellwit swiveled around in his chair. "Ah, you're back." Then he looked down at his lap. An ant had wandered from his bush shorts and onto his thigh. Bellwit flicked the ant away.

Mark watched as the ant arced through the air. Then, with a start, he became aware of the absence of ants. The chessboard was dead. The sugar-nozzles still glistened, the pieces showed a game in progress, but there were no ants.

"What happened?"

"Nothing," said Bellwit. "The ants just left."

"It's possible," said Roger, walking over to the display-table, "that the ants couldn't manage to play two games at once."

"Maybe." Mark stared at the chess pieces—a simple, middle-game position. "No. Something feels wrong here." He turned to Bellwit. "Tell me exactly what happened. It's black's move, obviously. What was your last move?"

"Rook to bishop one."

"So you picked up your rook, set it down at bishop one, and the ants just left. Is that it?"

"Well, not exactly." Bellwit sounded defensive. "These foil pieces are hard to get used to. I played pawn to queen's bishop three and when I put the pawn down, noticed that black had a powerful knight fork. Black hadn't moved yet, so I put the pawn back on bishop two, and made the rook move to prevent the fork."

"You took back a move?"

"Well, technically yes. But—"

"Then what happened?"

Bellwit shrugged. "The scout ants milled around a little, then went down through the holes. About a minute later, the scouts came back and then all the ants disappeared into the holes. That happened just before you came in."

"They play by tournament rules," said Mark. "I'd say they think you cheated."

"Cheated?" Bellwit stood up. "Don't be ridiculous. They're just ants—ants following a chess program. And they don't think."

"Maybe." Mark turned to Roger. "How are we stocked with sugar-formula?"

"We're running low. Why?"

"Could you whip up some more—ten liters or so?"

"Ten liters?" Roger whistled. "Yeah, I guess. Why?"

"I know this sounds silly, but I feel like I should apologize." His eyes darted around the trailer. There were no ants to be seen, but he thought he could hear the high-pitched squeaking of hordes of the creatures. "I don't like this. I think we might need that formula real soon."

"Yeah." Roger seemed uneasy as well. "I'll do it now." Glancing nervously around the lab, Roger left the trailer.

Mark turned to Bellwit. "You know, maybe this would be a good time for you to go back to the Institute. I could have Roger drive . . ." He stopped talking. Something was wrong. The squeaking that he'd been dimly aware of had stopped.

"What's the matter?"

"This isn't right," said Mark softly, more to himself than to Bellwit. He shook his head and a movement at the edge of his vision drew his attention. He snapped his gaze to the chessboard. Ants swarmed out of the holes in the display-table. As he watched, the worker ants took their places under the pieces while the scout ants scurried around the board—some of them riding the pieces and others clustering around the holes.

"Ah," said Bellwit. "It seems they're ready to go on with the game.

"Not quite." Mark watched as the ants reversed Bellwit's last move and substituted the one that he'd first made. "It

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seems they take touch-move seriously."

For their move, the ants executed the knight fork that Bellwit had tried to avoid.

"I can't play this position," said Bellwit. "I'd have to play the game of my life to win this. No. I'm not playing. In fact . . ." He looked back at Mark then froze, pointing.

Mark pulled his gaze from the chessboard, and looked where Bellwit pointed.

Ants. They streamed in from cracks in the walls, from behind the computer cube, from the windows, from the unused air-conditioning ducts. Thousands of ants, maybe hundreds of thousands, poured in until there was a carpet of ants, three deep in places, covering the entire floor of the trailer—except for a small circle around the display-table. Bellwit was within the circle, as was Mark. Still more ants poured into the trailer. They flowed over the furniture and some clambered up the walls—a tide of shimmering blackness rising toward the ceiling.

Mark inhaled sharply and smelled the strong aroma of Citronella!—the defense signal for leafcutter ants. "I think you'd better try to play that game of your life."

"What do you mean?"

Mark considered describing the ant carnage he'd witnessed outside, but decided against it. "Play carefully and not too fast. It'll give Roger time to whip up the sugar-formula." He glanced down at the seething mass of ants. "And for God's sake, whatever you do, don't take moves back."

While Bellwit concentrated on the board, Mark tested the boundary of the circle with the tip of a shoe. As he slid his shoe against the squirming mass, the ants pulled back. As an experiment, Mark tried to shuffle toward the door; the ants receded before him.

Fascinated by the movement of the ants, Mark glided slowly away from the chessboard. When he'd progressed about two meters, he turned and took a short sliding step back toward the display-table. He was just about to call out to Bellwit to abandon the game and move toward the door when he saw his foot covered with ants—soldier ants. Very carefully, he moved his foot back. The ants withdrew.

He could retreat, but the ants would not allow him to go back to the chessboard. He called softly over to Bellwit. "I'm going to help Roger with the formula. I don't think the ants will let you leave the game."

"No. Stay here. Please." Bellwit's voice shook and there was fear in his eyes.

"To what end? I can't get anywhere near you. They won't let me. But I think we can bribe them with formula." He continued toward the door.

"Bring insecticide," Bellwit shouted. "Do you have insecticide?"

"Of course not. Just hold on. As soon as I get free, I'll be back with the formula. Play carefully."

Mark shuffled faster—pushing the ants out of the way rather than waiting for them to crawl away on their own. He stopped short when he heard Bellwit laugh.

Turning around, he saw Bellwit pointing at the board. "They made a mistake. The damned ants played a wrong move."

From halfway across the lab, Mark strained to see the board. It certainly appeared to be a bad move. The ants were about to lose a rook.

Bellwit smiled broadly. "So, little ants, I'll bet you'd like to take that move back." He snapped up the rook.

Mark stayed put—waiting for the ants' next move.

The ants played their next move in under a minute.

Bellwit, his smile slowly fading, leaned forward and stared at the board.

"What's wrong?" Mark asked.

"A sacrifice," said Bellwit, softly. "They've played a brilliant sacrifice. I'd have seen it, but you said they never sacrifice pieces.

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"A sacrifice? I can't believe it."

"Believe it, damn it. I can't hold out much longer."

Mark could see Bellwit shaking, but couldn't tell if it was from indignation or fear. "Stay calm and don't let it get to you. Just play slowly."

Turning his attention to his feet, Mark struggled to the door, negotiating a painfully convoluted path through the cluttered lab.

Mark opened the door and looked back into the interior; the floor, walls, and now even the ceiling glistened with a thick, black coating of ants. Holding the door open, he wondered if maybe Bellwit should just make a run for it. No. Running that gauntlet would be suicide. Mark turned and let the door swing closed behind him.

The ground in front was devoid of ants and Mark set off at a run over the perpetually moist, springy soil.

As he burst into the supply trailer, he saw Roger taking a bowl out of the microwave.

"We were out of trypsin solution as well," said Roger over the thrum of the compound's power generator. "Had to brew more. What's happening at the lab?"

"Bellwit's playing out his game." Mark watched Roger stir the trypsin-ovomaltine mix into the sugar formula. "He's losing."

Just then, Mark heard a scream—long and tortured. He ran back to the door, shouting over his shoulder as he went. "Hurry with that formula."

Mark sprinted toward the lab trailer, mentally girding himself for slaughter. He'd have to squash the ants underfoot. He tried not to make value judgments—tried not to weigh Bellwit's life against the super-organism's existence. He hoped that even if he had to kill thousands of ants, the super-organism would survive—and would still be willing to play chess.

He shuddered with another thought. If he rushed to Bellwit's defense, how would the ants respond? Would he become ant food as well? Mark didn't know what was right—what was prudent. And he didn't have time to think it through.

Mark threw open the door. Instantly, his nose was assaulted with the odor of the leafcutter alarm pheromone—excreted from the mandibular glands of countless aroused ants. Bellwit lay sprawled on the floor near the display table. Ants surged away from his body.

The bulk of the swarm came straight for Mark. He held his ground and let out a sigh of relief as he saw that the ants ignored him, running around his feet as they swarmed out of the lab. He glanced over his shoulder and saw the ants streaming back toward their hives.

Bellwit moaned and Mark sprang over to him. The man's body was polka-dotted with ant bites—angry and red. And the fight had been fierce. Hundreds of squashed ants lay dead around Bellwit's crumpled form.

Conscious that he was about to say something very stupid, Mark asked, "Are you all right?"

Bellwit eyed him scornfully. "Peachy. Just peachy."

Mark helped him to a sitting position; Bellwit gasped in pain at every movement.

The door flew open and Roger ran in carrying the sugar-formula. He put down the container on a side counter and dashed over to the display table. "Jeez."

Together, Mark and Roger eased Bellwit into a chair.

"They tried to kill me." Bellwit began to shake. "If you hadn't come when you did, I'd be dead now."

"No. I don't think so." Mark, leaning against the display table, absently began to set up the foil pieces. "There's an intelligence at work here."

Roger cocked his head and squinted.

"I don't think they intended to kill." Mark pointed at the measles-like spots. "Bites everywhere—numerous but not

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vicious. And leafcutter bites can be really nasty. I think the object was simply a lesson."

"What are you talking about?" said Bellwit.

"They understand reward. Why not punishment? I think they were administering punishment for your taking a move back."

Bellwit snorted. "You make it sound as if I were an errant child."

"Perhaps you are—to them; perhaps we all are."

Bellwit touched one of the bites on his leg, inhaled sharply, and pulled back his hand "Just beastly savagery. *Über*-ants. Nonsense."

"Maybe." Mark turned to Roger. "Could you take Professor Bellwit over to your trailer so he can clean up? It would be bad if those bites become infected."

"Yeah. Sure."

"And afterward, would you take the 'rover and drive him back to the Institute? I've some thinking to do."

Roger nodded and helped Bellwit to his feet.

"Good-bye, Kenneth," said Mark, seeing Bellwit out. "And I'm sorry about the Hogarth. I don't know if it'll help, but I'll ring them up and try to put in a good word for you." He held open the door. "I'm sorry."

When they'd gone, Mark swept the carpet clean, then poured himself a glass of iced tea. He took a quick swig, then restlessly paced through the trailer.

All this time he'd considered the leafcutters as his little friends and he'd been too conceited to allow that they might be something more.

Mark stopped pacing and looked down at the deserted chessboard. *But they are something more.*

Could he communicate with them? Could he communicate with *it*?

He pulled off his glasses and nibbled thoughtfully on an earpiece. *What I really need is a nice sociable game of chess.*

He sat, took a long draught of tea, then reached over, hesitated, and pressed the green button.■

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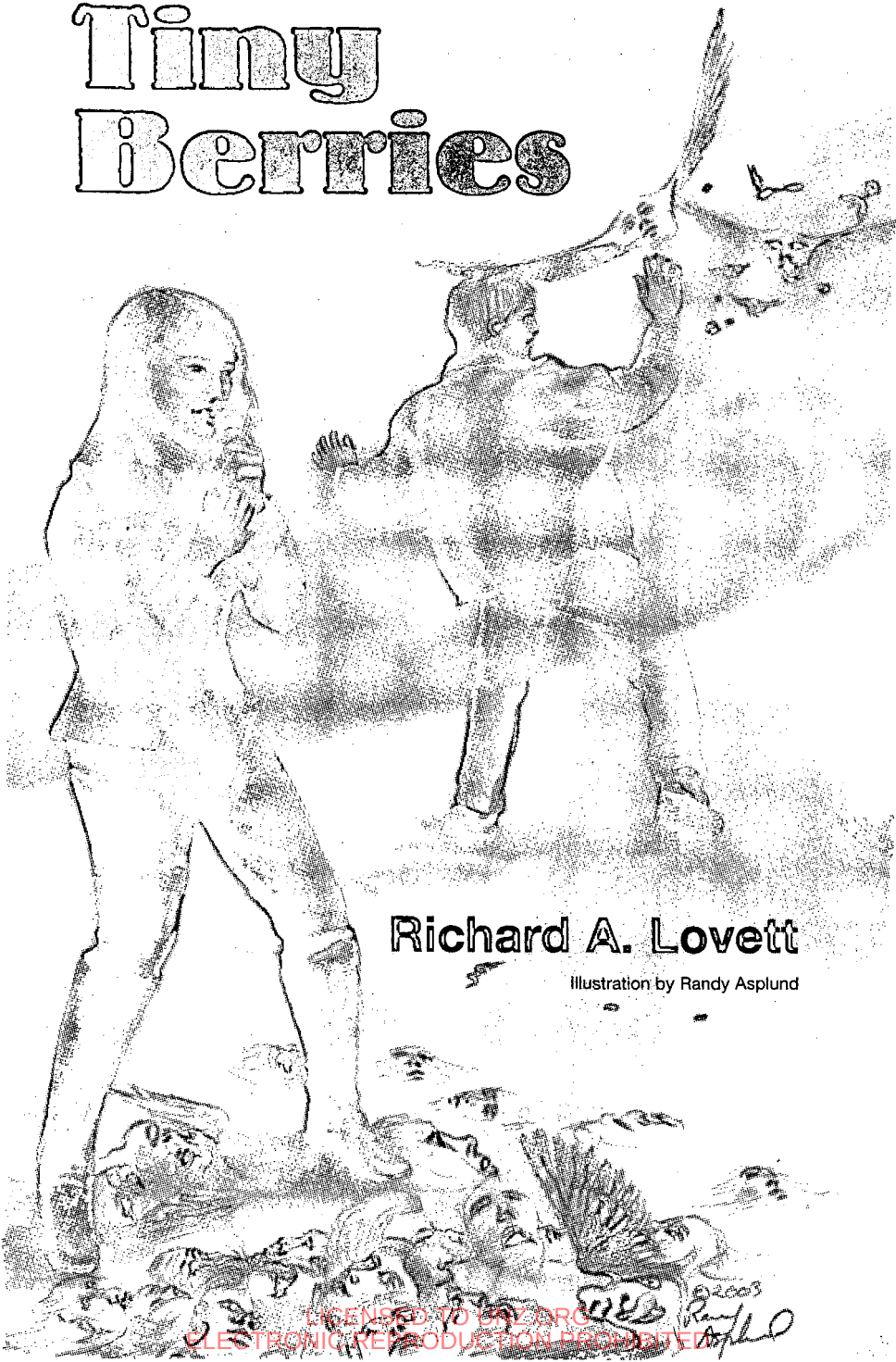
Tiny Berries



Richard A. Lovett

Illustration by Randy Asplund

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Of course, none of *us* has ever been in a situation like this. . . .

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It all began the morning the spammers hit my Hal 9000 alarm clock. "Good morning Dave," the clock's soothing voice began as usual, as it gently clicked to life. Only it and my sister get to call me Dave—the clock because it was just way too cool to pass up, and Sis because, well, that's what she's always called me. To everyone else, I'm David—David G. Harlin, Jr., to be precise. My father, the first David G. Harlin, was "Dave," and if anyone but Hal or Sis calls me that, I tend to sit around stupidly waiting for him to answer, even though its been twenty-some years since he and his cheap whiskey disappeared forever. Sis says that by ignoring the name, I'm trying to pretend he's still around. Me, I just think it's because old habits die hard.

"It's 7:00 A.M., time to rise and shine." Hal continued in one of a dozen follow-up messages he uses at random. "I trust you slept well." The next part of his routine normally fit seamlessly with the rest, but today there was an uncharacteristic hesitation as he accessed the Web. "No rain in the forecast, highs in the low 70s," he continued a heartbeat later. "Traffic is heavy on the Sylvan Hill, but Canyon Road appears to be a viable alternative. Remember, you have an appointment . . ." Again the pause as he consulted my office calendar.

To this point, I'd been snuggling under the sheets vaguely wondering why wakeup calls always came in the midst of the best dreams. I'd been on a beach, basking in the love of someone who seemed to have always been part of my life, even though my slowly waking mind had finally reminded me that it had been a long time since I'd had a girlfriend. Still, she seemed familiar. Was she merely a figment of the dream, or could my subconscious be urging me to pay more attention to someone I already knew? In the dream, I'd felt as though I'd been with her forever. Now I was struggling to recall the most basic aspects of her image as wakefulness blurred it to little but a vague impression of "blonde."

Suddenly, Hal was no longer his usual smooth self. "Attention!" he blared like a foghorn. "I have just received an important announcement!"

The beach and the blonde evaporated into total alertness. *Who died*, was my first thought, followed by, *What did I forget?* Was I supposed to be having breakfast with the product development team? Had I planned on calling my broker before the market opened back East?

Having secured my full attention, Hal continued in the same urgent tone: "An incredible medical breakthrough has been reported by scientists deep in the Amazon jungle. Working with a remote tribe, they have found a tiny, miracle berry that combines the benefits of Prozac, Viagra, and human growth hormone, all at once. Male or female, you can now stay healthy and vigorous into your 80s and beyond, add three inches to your penis or enhance your bust size by—" The message died as I punched the disconnect.

I'd acquired Hal three months ago at a trade show where one of my firm's suppliers was giving the clocks away as favors. If I'd preferred, I could have had Mickey Mouse, Woody Woodpecker, Marilyn Monroe, or any of several underclad pop divas. I'd been assured that the Web connection had an unbreakable firewall, and there'd even been a written guarantee from the manufacturer, although I vaguely remembered a caveat about it applying only to existing worms, viruses, code-breakers, and net-probes. Nobody in their right mind guaranteed there wasn't somebody smart enough to beat them. It was an exponentially mounting problem. In the past year alone, I'd been forced to give up both cell phone and my fax as each in turn was so swamped in ads that they'd become useless. Was the clock next?

Luckily, there were no other smart electronics in my bedroom. I switched

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on an old-fashioned FM radio, disconnecting the cable input when it started blatting about berries. There aren't many stations that still bother to broadcast over the airwaves, but there are a few, and I listened to public radio, uninterrupted by even the most benign ads—which at the moment would have seemed quaint.

In the kitchen, a blinking light indicated that I had messages on my unlisted phone line. There proved to be three—one from a political candidate who instantly jumped to the top of my list of those to vote against, another from Sis, reminding me that tomorrow was Mom's birthday, and a third from Tiny Berries, which this time managed to inform me how much my bust would enlarge before I could hit the erase button.

I'd had the phone number for less than a week. It should have been at least another couple of months before the spammers started finding it. I wondered if Sis had accidentally led them to me by programming my new eighteen-digit number into her autodial, where somebody'd managed to hack it. The older fifteen-digit numbers were supposed to slow down the phone solicitors by hiding each functioning number among thousands of nonfunctionals. I was paying a premium for three extra digits designed to increase the difficulty by another factor of 1,000. But such defenses only work if nobody ever puts the number in an electronic database. Even then, they're merely stopgaps; the spammers always catch you eventually.

Once I was on the road, I confirmed Hal's traffic report with my superBMW's autodrive. It too preferred Canyon Road, so I gave it the go-ahead and sat back to scan the business headlines as the car swung onto the quasi-freeway that allowed me to bypass the congested section of the real one.

I'd barely begun to relax into the day when my news-worm's offerings were replaced by dancing cartoon images of male and female figures whose exaggerated genitalia looked like something from pre-Columbian art. "Amazon villagers can be sexually active into ripe old age," a scrolling header announced, "thanks to a tiny, miraculous berry found only in the deep jungles of eastern Bolivia . . ." I blanked the screen and thought bleak thoughts all the rest of the way to work.

Mondays are always hectic. My firm still shuts down (mostly) over the weekend, but net-business doesn't, and there's always a frantic need for us real people to catch up with what's been happening on the Web. In theory, I'm not part of that short-term stuff; in practice, I usually get drafted for something. There simply wasn't time to tend to my personal firewalls, although I did take a moment to add "tiny berry," and "Amazon" to the list of interdicted terms on my e-mail screener. "Penis," "bust," and "three inches" had long been on the reject list. Not that the spammers weren't wise to this. They'd simply vary their diction and get in again, until I blocked another list of terms—an escalating war eventually fated to use up the entire language. Out of curiosity, I punched up a summary of my reject file and found that it now contained 457 words and 1,236 phrases. I toyed with porting the entire list into Hal, but half the terms in the weather forecast and traffic report were probably in it. Did I really want to block a prediction for three inches of snow?

The next morning, I was forced to concede that a crisis was looming. Hal barely made it through his "Good morning, Dave," routine before Tiny Berries found him. That ad was followed, moments later, by one from a mortgage broker, then another from someone wanting to consolidate my debts into one low, monthly payment. Since many of my debts were incurred buying antispamware that was obsolete before I finished paying for it, I was not amused.

My phone contained eight messages, all regarding berries, octogenarian sex,

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and natural Viagra. When I called Mom to wish her happy birthday, I discovered that her voice mail was full. An attempt to convey my wishes by e-mail produced the same result—no surprise, because Mom has always been slow to update her spamware. "I shouldn't have to pay good money just to keep people from harassing me," she'd complained for years. I myself have months when my firewall expenses exceed my car payments. It's been said that without the hackers and the firewall industry they sparked, the economy might still be mired in the last tech recession.

Unfortunately, Mom's frugality left me with few options other than telepathy. *Happy Birthday,* I thought at her across the miles, but somehow I doubted she'd get the message. Hell, if someone ever figured out how to harness telepathy, civilization truly would come to an end as a million and one spammers invaded everyone's brain. We'd all wind up jumping off bridges or throwing ourselves in front of trains just to quench the mental clamor.

My commute started smoothly, and I'd read most of my news queue when my car left the freeway at Water Avenue, not on my usual route. I checked the heads-up display for congestion reports and found none. So why had my car chosen to exit at Water Avenue? Nothing was there but warehouses.

A moment later, the autodrive gave the answer. "SPECIAL OPPORTUNITY!" the heads-up proclaimed in hot-pink capitals. "TINY BERRIES, just ahead." The car pulled onto a side street and ground to a halt. "Enlarge your penis by three INCHES!" the display added, with a vulgar graphic.

A van with a mud-spattered license plate was parked beside the road, where a long line of automobiles were queued up, as at a fast-food drive-through. "Get your tiny berries here!" read a hand-lettered sign, propped against a lamppost.

A middle-aged man was leaning out the window of the lead car, gesturing angrily. Apparently, he lost the argument. Money changed hands and he accepted a paper sack. His car engine roared and he sped off, trailing an arm out the window in a rude gesture that had all the inches it needed.

I tried to disengage the autodrive, but it refused to relinquish control. "BUY now!" the heads-up flashed. "Natural VIAGRA! Bust enhancer!" And, more ominously: "Purchase a three-month supply and get to work on time for the rest of the year. Guaranteed!"

The line inched ahead, as I fought the autodrive. Then, a few car-lengths before I reached the van, I heard distant sirens. The autodrive released and I was finally free to pilot my own car. The van gunned to life and disappeared around a corner.

I was nearly two hours late when I finally reached the office. Tiny Berries had delayed me by only a few minutes, but the police corralled me and a dozen others before we could find our way back to the freeway. Then we had to wait for a computer-crime investigator to reach the scene. I occupied myself as I always do when I'm in for an unavoidable delay, reading trade magazines and jotting notes in their margins. I may not have much of a life, but I spend it efficiently.

I was well into my third magazine when I sensed motion in my peripheral vision. It was the investigator, come to download data from my autodrive. All of the other cars had left. "Thanks for being patient," she said.

I tossed my magazine onto the passenger seat and opened the door to stretch my legs while she worked. "Nothing gained by fretting," I said as I climbed out.

"True, but most of the people I've talked to this morning would rather have been ripped off if they could have gotten it over quickly. If I could do it over, I'd have made a couple of them wait, just to prove they're not really as

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important as God." She tempered the remark with the hint of a smile, but it was short-lived and didn't quite mask the intensity behind her words.

She was Asian, perhaps thirty years old, and casually dressed in a checked shirt and hip-hugging jeans—not at all my image of a police investigator. She was tall for an Asian, with a swimmer's muscles and raven hair that spilled across her shoulders in layers that ended with a flourish at an attention-gathering location, just above a shirt pocket where an official-looking tag proclaimed her to be Tina Nakamura.

Leftover images from Monday's dream were still wedged in the back of my mind like psychic splinters, and I tried to picture her on a beach. The concept was appealing, but my subconscious was hung up on blonde. Besides, she was a cop and I knew nothing about cops except what I saw on TV. To rid my mind of beaches, I tried to substitute an image of her grilling suspects in a precinct back room, but I pulled a blank. But then, her job was to interrogate my computer, which wasn't a suspect and wouldn't know the difference if it were.

She slid a laptop and assorted cables onto the car seat and crawled in beside it, head under the dashboard, looking for dataports. "Congratulations," she said glancing back over her shoulder with a smile that now sparked her eyes as well as her face. "You have the dubious honor of being one of the first victims of a new crime. I'm thinking of calling it spamjacking, but maybe the victims should choose the name. Any better ideas?"

If her goal was to pull a return smile out of me, she'd succeeded. "Cute," I said, and again felt the jab of psychic splinters as my subconscious asked whether I was referring to the word or the woman. When she turned back to the dashboard, I found myself admiring the hip-huggers. "Do you think you'll catch those guys?" I asked in an effort to keep my thoughts professional.

"Dunno." With the gearshift jabbing her in the diaphragm and the dashboard muffling her diction, her voice had lost the clear, rounded tones that are the closest thing there is to a West Coast Asian-American accent. "The ones in the van, maybe. That stunt wasn't too bright, and they peeled out so fast they forgot to pick up their sign. It'll be interesting to see what the lab finds on it. Too bad the boys in blue scared 'em off by hitting the sirens." She grunted as she squirmed deeper behind the dash. "Damn, they make these things hard to reach—lucky for the mechanics that autopilots rarely have to be externally booted." There was a click. "Gotcha!" She shoved herself back onto the seat. "Where was I? Oh yes, what I really want is the source of the hack. That was serious stuff. Technically, you've been kidnapped, held hostage, and extorted. Well, almost extorted—the sirens did save you from having to buy their silly product. Not to mention that hacking an autodrive is inherently dangerous. But these guys probably weren't the masterminds. Most likely, they bought the hack off some website run by people who know how to cover their tracks."

Numbers and file names were scrolling across the screen of her laptop. "Nice zippy little car," she said. "I'm surprised to see you've not overridden any speed limits."

I did my best to feign shock. "That's illegal," I said with mock innocence. Actually, I'm very law-abiding—Sis calls me a "stuffed shirt"—but even to a police investigator I found it hard to admit I really was *that* conventional.

"So was the carburetor on my granny's old Ford. Doesn't keep people from doing it. Especially with liberal judges saying that it violates perps' rights against self-incrimination to use their own computers against them."

It was the first time she'd sounded like a cop. She sensed me tense, and shrugged. "It's true. I'm not saying we

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should stop motorists at random and read out their drivelogs, looking for minor infractions. But the computer-incrimination ruling sure makes my life a lot harder." The disarming smile resurfaced. "Of course, it also helps keep me in business."

The computer beeped, and she turned her full attention to the screen. "That's it," she said. "They tagged you when you were approaching the Marquam Bridge, but waited until just before the exit to assert control. It looks like they came in through a NASA site . . . Why on earth would you be linked to that? Oh—of course, it's the satellite feed used by Metro for real-time traffic monitoring. Wow, talk about coming in a backdoor. The feds and Metro are gonna *love* this."

"Is that how they got the others?"

"No, everybody appears to have been different. One came in with the weather report, another via the news feed. I've not taken time to look at all of the others yet, but I'll tell you one thing—this was one sophisticated hack. I hope it's not the wave of the future. Luckily for you, somebody still had a cell phone and dialed 911."

Once I got to the office, I was in no mood for work. Officer Tina had shown me how to pull the plug on my autodrive so it couldn't be hacked again, but I knew I'd soon be looking at yet another round of upgrades. These things usually come in waves when a break in hackware renders firewalls obsolete. Upgrading is like changing the oil in your car—you've got to do it every few months or the whole thing can seize up on you. But Mom's right: I really, really hate spending the money. Normally, I'm pretty passive about it. I grumble, then grudgingly buy the upgrades when they come out. But this time, someone had elected me to be one of their first guinea pigs, and it might be a while before upgrades appeared, especially if I didn't help do something about it.

Tuesdays are as slow as Mondays are hectic. After an unproductive hour, I skipped out of the office ahead of my usual lunchtime and went in search of Bobby.

Bobby Montgomery and I go way back, all the way to the summer after eighth grade, when his father, an attorney, had run off with a summer intern at about the same time mine made his final choice between booze and family. We met when we wound up paired against each other on opposing soccer teams. After being expelled from the game for fouls that escalated all the way to fisticuffs, we found ourselves banding together with the instinctive desperation of teens in a hostile world. I'm not sure I would have survived without him—but our families barely survived *us*. Alone we were desperate and withdrawn. Together, we were a holy terror. Sis locked herself in her room and turned up the volume on her stereo whenever we were around. Aunt Irina dubbed him Dracula Pipsqueak when she moved in for the summer to look after us kids while Mom desperately sought employment. Only Mom realized that we were each other's lifelines to sanity.

In high school, Bobby discovered computers and did a lot of things that would have landed him serious jail time if he'd been caught. Luckily, that's when he met Jill. She saw the genius behind the delinquent, and slowly eased his fury. Under her gentling lead, he segued from breaking into computers to defending them. Pipsqueak Systems operates out of modest offices in Old Town, but it's one of the best firewall designers in the business.

Bobby's secretary waved me into the inner sanctum, where I stuck my head inside without knocking. Unless Bobby's on the phone, his door is always open to friends.

"Hey, David," he said, looking up from a laptop computer. "Where've you been hiding?"

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He always says that, even if it's only been a few days since we last saw each other. My response is equally traditional. "Nowhere particular."

It had actually been quite a while since I'd last stopped by Bobby's office—long enough that he'd substantially refurnished it. The laptop replaced a flatscreen monitor that once rose beside him like a giant domino, and now the desk was starkly empty but for the portable computer, a telephone, and a small stack of folders. Like me, the adult Bobby who emerged from his chaotic youth abhors clutter. It's undoubtedly one of the reasons he now devotes so much of his talent to firewall design. Hacks and spams are inherently messy.

Bobby had also redecorated his walls, although that was no surprise. Some years ago, he'd discovered a gallery that allows you to rent paintings, swapping them out at will. He could have afforded simply to buy the art he wanted, but he liked the idea of not having to store it when it wasn't on display, and he had no interest in the ostentatious stuff, anyway.

I'd not figured out exactly what I wanted to say, and with Water Avenue fresh in my mind, the *nowhere particular* response wasn't really all that accurate. "Actually," I said. "I've got a problem."

Bobby snapped shut the lid on his computer and shoved it aside—a simple gesture saying I had his full attention for as long as I needed it. "Fire away," he said. His billing rate is so high that the simple act of saying "hello" probably nets him more money than I spend on lunch, but with me he always behaves as though he has all the time in the world—just as, even in the intensity of our youths, there were plenty of days when the two of us would take to the woods behind his home to throw stones in Longmeadow Creek, listen to summer crickets, and try to figure out the world. What Officer Tina saw in me was simply a reflection of Bobby, rubbed off by years of proximity.

I started to sit in his visitor's chair but was too agitated to stay in one place. Bobby's office might not be in the trendiest part of town, but it's large and has big, corner windows in one of the taller buildings outside the financial district. Standing close enough to the view that I could feel the visceral drop sweeping away in two directions, I told him about the spamjackers, then for good measure mentioned Hal, my no-longer super-secret phone number, and the dancing images on yesterday's news feed.

To my surprise, he was more intrigued by the hack on Hal than the assault on my autodrive. "I always thought those car things were vulnerable," he said. "That's why I drive a brain-dead Civic. If I crash into something, by golly, I'll be the one who smacks it, not some screwed-up computer."

With difficulty, I suppressed a grin. Bobby loves electronic toys as much as I do. He just knows too much about their vulnerabilities.

"The clock is different. The strength of those limited-purpose gadgets is supposed to lie in their simplicity. They're hardwired to accept information only from the Web sites you choose on the first day, and only under safeguarded protocols. Reprogramming them is supposed to require buying a whole new chip. Anyone who can beat that can hack just about anything. By the way, did you say the clock was connected to your memo calendar?"

I'd been watching the street people in their endless quest for quarters, twenty-five stories below, but now I turned to Bobby and nodded.

"Careless," he chided. "They probably got your password while they were spamming you."

"Damn, I never thought of that." Yesterday morning I'd been haughtily wondering whether Sis had stored my phone number in her autodial when, of all stupid things, I'd programmed Hal with a *password*. Someday, my love of gadgets

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would be my undoing. Maybe it had already happened.

Bobby shrugged. "What's done is done. But change that password. That was one sophisticated hack."

The familiar phrase pulled me out of what was setting up to be an extended bout of self-recrimination. "That's exactly what Officer Ti—I mean Nakamura, said about the car hackers." Windows forgotten, I paced the office, trying to remember what she'd told me about NASA and the weather channel.

"Sounds like someone's testing new products," Bobby said. "This could get interesting."

Problems Bobby finds "interesting" have been known to shake up entire industries. "How 'interesting'?" I was starting to ask when Jill appeared in the doorway.

"I'm off to lunch," she called to Bobby. "Want to join me?" She leaned far enough into the room to spot me in the corner where my prowling had most recently landed me. "Oh, hi David. I didn't know you were here."

Jill is the business half of the team. In college, when Bobby was delivering pizzas to feed his computer habit, she'd been pursuing an MBA. The year after graduation, they'd founded their own business and never looked back. Her genius had been the realization that in the obsolete-before-it's-in-production computer world, it was safest for a start-up company to distance itself from the end user. From the outset, her goal had been to be everybody's favorite subcontractor. That had worked so well that one business school text now contained a sidebar lauding the "Pipsqueak theory" of small business, a good laugh to those of us who knew the real story behind the name.

"David's been telling me about a really slick hack," Bobby said. He may have gone straight long ago, but he still feels the outlaw's glee at beating the system. It's part of what makes him so good at what he does. He glanced my way. "By the way, I take it—"

A shallow nod was all the confirmation he needed. It was one of those "I know that you know that I know" type of things. Yes, I was giving Bobby a head start in what could be an important spamware race, and no, I wouldn't take a piece of the action, and there was no sense arguing about it. Chalk it up to all those days playing hooky down by the creek.

"Thought so," he said. He reached for his laptop and pulled it back toward him. "Francine and Raul did their usual great work on the Boeing project, but I need to spend a little more time reviewing it before we ship. I think I'd better do that ASAP, so I'll pass on lunch." He frowned slightly, reconsidering. Even after all these years, the allure of lunch with Jill wasn't something he'd easily pass up. Then he was back in executive mode. "Yeah. David's new one looks like something we're going to want to get on top of right away."

"Shall I bring you back a sandwich?" Unspoken was that Jill would also be eating at her desk, shuffling work assignments to clear the deck for "my" new project. That's how it is in an instant-turnaround business like spamware. If Bobby didn't beat this thing, somebody else would—or it would take over the world and trigger a micro-recession. In spamware, you're always playing for high stakes, although Bobby seemed content to leave the worries to Jill.

"Whatever," he said. Jill grinned at him and he beamed back. They both knew that without her mothering, he was a nutritional disaster area. When an "interesting" problem gripped him, he'd eat whatever you thrust in front of him and be unable to name it a moment later.

"Back in a jiff," she said. She gave me a cheery wag of the hand and walked out.

"Walked" is actually too bland a word for the type of locomotion Jill can turn

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on when she's in the mood. Usually, I think it's sweet. But this time, I found myself staring uncomfortably into the space she was in the process of vacating. It wasn't the sashaying gait that had my attention—it was the medium-cut hair bobbing on her shoulders. Over the years, she's worn it many ways—short, long, curled, straight—but she's never tampered with its color. Not that she needs to. She's the archetype of the California sunshine girl, even though she'd been born in Seattle.

You see, Jill is blonde.

Her hair color alone is enough to stir thoughts of beaches, and she's beautiful enough to have pursued a modeling career. All of this I'd known for years, but I'd never given it much thought because Jill is very much a one-man woman. When Bobby isn't around, she's friendly and pleasant—a good listener, a fun companion for a dinner group, someone who rated highly among my admittedly small circle of friends. It's only when he's present that she turns on the sexual energy, and then the wattage is directed only in one direction. I've never known whether it's conscious or unconscious on her part, but Bobby never fails to notice. So do his other friends. "I love to watch how he comes alive when she enters a room," one of them once confided to me.

Jill was gone, but I found myself staring after her several heartbeats later. My dream memory was sufficiently fragmentary that I'd never be sure, but if the woman on the beach hadn't been her, it was someone closely modeled on her.

Bobby broke his own trance to return to business. "I'll have this project done in a couple of hours," he said. "Would it be possible for me to talk sometime soon to that police officer of yours?"

"I'll check," I said, starting to make my own exit. Bobby raised a querying eyebrow—a gesture I'd once watched him spend hours perfecting. So far, this visit had been all business, and before getting back to work he was probably expecting at least a brief update on Sis and Mom. But I needed to get away, and do it soon. Except for the hours when he is truly in the throes of an interesting problem, Bobby is one of the most socially astute people I've ever met—and he knows me far too well for me to be able to hide anything from him for long. "I ought to at least make an appearance at work," I said, though it sounded lame. "I'll get back to you later." What I really needed was to do some serious thinking. *Was I secretly in love with my best friend's wife? And if so, what was I going to do about it?*

Bobby stared at me for a long moment. Then he popped the lid on his laptop and waited for the machine to whir into wakefulness. "Suit yourself. Don't forget to change that password."

I'd like to say I started doing my serious thinking on the way back to the office, but all I did was walk in a daze that nearly got me hit by a bus. Even in the office, what I wanted were distractions so I could postpone the thinking I knew I needed to do. I found one right away in my electronic appointment calendar.

I'd not consulted it since yesterday afternoon. Now, the first thing it did was to tell me I was missing an appointment to buy tiny berries. As I watched, that switched to a notice offering discount car insurance. Scrolling ahead indicated that my entire life, as far ahead as I cared to peer, was booked in ads. Scrolling backward showed that the spam must have started coming in at about the time I was on Water Avenue waiting for Officer Tina.

As a test, I cleared out the junk on today's schedule, created an appointment to call Officer Tina in ten minutes, and sat back to see what happened. One by one, the open slots filled, but the "real" appointment wasn't overwritten by Tiny Berries or anything else. Good. That meant my schedule was salvageable, although I didn't have the energy to sort it out today.

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My job is technically in the marketing department, but except for the Monday frenzy, I'm mostly a technical writer, serving as an interface between the design engineers and management. A lot of it's routine, and I pretty much set my own hours—something nobody complains about, because I work a lot of them. I'm one of the few people in the company who truly understands both the technical people and the marketing folks, and I could probably ask for a big raise if I wanted it. But being underpaid has its advantages, not the least of which is that it's easier to get away with dodging most of those boring project meetings that jumble up everyone else's schedule. Because they don't *really* need me until fairly late in the product development process, I can often get through two or three days in a row without having to talk face-to-face with anyone.

In fact, other than "call Officer Tina," now blinking at me from the screen, I had nothing important on today's schedule. I changed the password, cleared out everything but Officer Tina from the day's calendar, and reached for the phone.

I stopped with my hand hovering above the handset. *Oh, damn.* The appointment calendar was a modular system not connected to any of my other computerware, so I didn't have to change other passwords. But it was linked to the phone so I—or Hal—could dial it up remotely. If the calendar had been hacked...

I punched up my voice mail and found 164 messages. So much for that line. Lucky, my company could simply give me a new extension code, but I'd have to remember to give the number—again—to folks like Bobby, so they wouldn't be forced through the switchboard. Out of morbid curiosity, I dialed my home phone, finding that it had twenty-nine messages. I started a quick scan, sampling them one at a time, then paused when I heard Sis's voice. "Hi David," she began—a misstep that should have prepped me for what was to follow. "Don't hang up—I have a very important message for you. A friend recently told me about a tiny berry—"

In a panic, I hit the skip code before I had to listen to Sis talk about my penis, then summarily blanked all twenty-nine messages. This was a quantum leap in the invasiveness of phone spam. Not only were these guys progressing rapidly, but they had a phenomenal ability to link up information, such as my phone number and Sis's voiceprint. Bobby was going to have his work cut out for him on this one, and for the first time, I began having doubts. What if these guys couldn't be beaten?

My appointment calendar was continuing to urge me to call Officer Tina, so I decided it was a good time to take that advice. I phoned the Eastside Precinct, got routed to Downtown, then landed in the main switchboard. "I'm trying to reach Officer Tina Nakamura," I said for the third time.

There was a long hesitation. "Officer who?"

"Nakamura. In computer crimes," I added helpfully.

Eventually, I was routed to someone who identified himself as Sergeant McLusky. "Who?" he asked for the umpteenth time.

I could feel my exasperation growing by the moment. "*Nakamura.*" When I was young, people used to complain about voice mails that switched you through phone systems without a chance for live, human guidance. Now, when nobody would dream of permitting automated access to extension codes, it's obvious that live humans were overrated. Sometimes, I long for the old, impersonal days, when you could just type someone's name into a phone and ring them up directly. "N-A-K-A-M-U-R-A," I said. "Officer Nakamura. I'm calling to talk to her about that natural Viagra scam from this morning." When that still drew a blank, I added,

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"I'm one of the people who was stranded over on Water Avenue."

"Oh! You're a computer vic. You need to talk to Tina."

Tina had been wrong. My patience is far from perfect. "*Yes.*"

"She can't be reached through this switchboard. Can someone else help you?"

"It's kind of personal," I said, realizing a second too late that he'd think I was trying to get a date. But at least it would move me in the right direction.

"Okay," he said, although his tone said otherwise. "I'll pass on the message. But it might be a while before she calls you back. She'll probably need to use a public phone."

That was strange. My company had dozens of throwaway lines for outgoing calls. Even now, I'd automatically used one. Letting people learn your real phone number is like sex—bad things can happen if you do it too promiscuously. In business, throwaway lines are the simplest defense: nobody answers them if they ring back, and when they do start getting clogged with incoming calls, replacing them is no big loss. I knew the city was in a fiscal crisis, but how could it survive at all without enough phone lines?

Still, there was no choice but to wait. I gave Sergeant McLusky a backup code that that would ring my office, but not my voice mail. If Tina was slow to call back, I could always switch the temp line into a short-term voice drop, but for the moment I wasn't going anywhere. Then, having not done any work all day, I decided it was time to get started.

Any writer knows that the hard part is composing the first draft. If you're prone to writer's block, that's when it happens. If you're not, you may still produce nothing but drek. The reports I write aren't high art, but they have to be both accurate and comprehensible, and to make that happen, first drafts take concentration, skill, and a certain degree of inspiration.

Revisions are a different matter. Even with Jill, Tiny Berries, and the pending callback from Officer Tina rattling around my brain in a weird stew, I could still edit, and the perfect project was waiting in my in-basket: a hydrology report I'd been asked to look at regarding a research complex we were building in Minnesota. It was way outside of my usual bailiwick—what I knew about hydrology wouldn't fill a thimble—but our St. Paul division was short on technical writers and the home office had figured that if I was good at converting project engineer-speak into English, I could do the same for hydrology. That's the downside of being underpaid—you can't claim your time is too valuable for tasks like this. The whole mammoth document—300 pages, counting appendices—was destined to be boiled down to a few paragraphs in an environmental impact statement which was so noncontroversial that nobody would ever read *it*, either. It wasn't as though we were building a chemical plant that might pollute an aquifer—to the contrary, the new facility was to be an environmental showcase, whose grounds would include hundreds of acres of artificial wetlands, a prairie-restoration project, a carefully husbanded riparian zone, and miles of hiking and bicycling trails that would be deeded to the county as a park. It was a great project—and probably good PR—but the home office was acting under the illusion that the press might actually *read* our technical reports.

What I had now were the hydrologists' comments on my rewrite, which should be easy enough to deal with even today.

I downloaded the document from my in-basket and took a sip of coffee as the word-processor booted up. In my current mental state, I needed a tranquilizer more than I needed caffeine, but like most people I gravitate toward beverages that exacerbate my mood swings. If you're feeling depressed, you hit the

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booze. If you're already excited, you drink coffee. I sometimes think the flight reflex, however good it may have been for protecting our ancestors from saber-tooth tigers, is one of our greatest enemies. Too often, when we think we're running away from whatever it is we don't want to be, we make ourselves into even more of it until, like my father, we disappear completely. Just as I was now trying to bury myself in work to avoid thinking about Jill. *Was I really in love with her? Did I even want to know the answer?* Defiantly, I took another sip of coffee. I did *not* have to deal with this now.

Ironically, it was a spammer who pulled me back to the present. Someone had invaded my report. Instead of the expected title page, it now opened with a stylized drawing of a computer monitor. "Click here to find out how to learn anything about anybody," read a line of text beneath the monitor.

The next page was more of the same. "Find out what your lover's been hiding! Check the financial history of business associates! Fight back against your enemies! WebPARSER software can sift the smallest details from the Internet. Faster, better, and more THOROUGH than ever . . ."

Thankfully, the report began on the next page. Frustrated that our Internet server hadn't blocked the hitchhiking ad, I deleted it, being careful not to accidentally activate the Web link. The hydrologists shouldn't have sent this to me over the Web, anyway. Even when there are no trade secrets worth stealing, it's better to make sure there can be no unauthorized copies of the draft out there to embarrass you when the final version goes public. Not that I'd ever heard of that happening. But now, it felt as though the entire façade of Web-based society was crumbling around me.

I was thoroughly tired of hydrology by the time Officer Tina rang back. From the street sounds in the background, it sounded like she really was calling from a pay phone. Curiouser and curiouser. I remembered her lack of uniform and wondered if this whole thing had caught her on her day off.

"Did they page you at home?" I asked impulsively. I too would use a pay phone to return a call from a virtual stranger. Throwaway lines aren't so cheap the average person has one at home. "If so, I apologize. It could have waited."

"Not exactly home," she said cautiously. "I'm trying to put a face to your name, but I don't have my notes."

"I was the last one," I said. "In the superBeamer."

"Oh, sure. How could I forget? The patient one." Her voice was still cautious, but now carried a trace of the smile I remembered. My pulse quickened, but her next remark was pure business. "I'm afraid the lab found nothing on the sign. That makes it hard to catch the guys in the van until they get greedy and try it again—which they probably will. As for the hacker, all I can tell you is that these things take time, but it's only through folks like you that we can catch them when they slip up."

"That's not what I was calling about," I said to spare her from having to give me another PR line. I told her about Bobby's request. "He'd like to nip this thing in the bud, and could use whatever technical information you can share."

"You know Bobby Montgomery?" I belatedly realized that in her field, Bobby was something of a legend and that I could probably move up in her eyes by telling her how well I knew him. I was startled by how much I wanted her approval. If I was subconsciously in love with Jill, why the hell did I care about impressing Tina?

But some things are sacrosanct, and I wasn't about to use Bobby to score points with a woman. "Yeah," I said, "but that doesn't mean I know all that much about computers."

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Surprisingly, she laughed. Then she shifted the subject. "I should probably tell you that you created quite a stir in the precinct by asking for 'Officer Nakamura,'" she said. "In the police subculture, 'officer' means something quite specific and it's not me. I'm just a sometimes-consultant who gets called in for a few of the more difficult computer cases. In real life, I'm an ABD in cultural anthropology."

"ABD?"

She had a very pleasant laugh. "Sorry, that's Ph.D. shorthand for 'All but Dissertation.' It covers a rather wide range. If I don't finish soon, they'll kick me out. You didn't catch me at home; I spend a lot of time at the university."

"Sorry," I said, "I saw the badge and jumped to a conclusion."

I couldn't see her, but I had a hunch she was rolling her eyes. "It's not a badge—it's an ID card. Even the janitors have them." The exasperation left her voice. "Actually, it was kind of cute. Sergeant McLusky darn near transferred you to Officer Louise Nakagawa in Vice. Now *that* would have been entertaining if you'd started with the same line about Viagra you gave to McLusky. Louise has *no* sense of humor."

ABD Tina must have reached Bobby in record time, because he was back to me fifteen minutes later. He must also have learned about the promotion I'd accidentally given her, because he thought it was as funny as she thought it was cute.

"You've got to come out of that hole of yours more often and see how the rest of the world lives," he teased, and I was startled by how much the friendly jibe stung. As he spoke, vague images of running, hiding, and saber-tooth tigers flitted at the edges of my mind like shadows around a primeval campfire. Between Bobby, Tina, and Jill, I was feeling a growing pressure. When the moment of truth came, would the result be an explosion, or an implosion?

Bobby was still talking. "For starters, the four of us—you, me, Jill, and plain-simple-'Tina'—are going to get together tonight at Museum by Night. There's a jazz combo playing that Jill and I wanted to catch anyway, and Tina's checking with the precinct to see what data she can share, given that it's an ongoing investigation. At a minimum, she ought to be able to give me the download from your car, because I could always just download it from you again, from scratch. It's also unlikely that they'll stop her from sharing her general observations—even if some privacy thing kicks in to protect the other downloads. That's enough to give us a good start. If her bosses get obstreperous, I'll just hire her out from under them at double her current salary and make her part of the project, with or without the data. There's no law to stop her from going private-sector whenever she wants."

I suggested to Bobby that a concert might not be the ideal place for a business meeting, but he wasn't buying it. An evening meeting would give him all day to finish his current project, he said, and it would be fun to get acquainted with Tina in an informal setting. "'Officer' Nakamura," he added. "Man, you gotta get *out*."

Museum by Night had begun as a quiet fundraiser for the art museum, where artists performed in an atrium, flanked by modern sculpture and impressionist paintings. It's grown into one of the city's larger singles-mingles, although couples like Bobby and Jill also attend. The couples are the ones who find seats at the cabaret-style tables and actually dance or listen to the music. For everyone else, it's a once-a-week opportunity to swill pricey wine and try out sophisticated pick-up lines in an upscale cacophony in which you have to press close together merely to exchange a few words. I attend once or twice a year, mostly as an exercise in culture watching. Better than any men's magazine, it's

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my clue to the latest trends in urban clonewear, and I'm always amazed by how the fashion elite can shift attire in unison, moved by some signal I never manage to hear.

Last year, black turtlenecks had been the rage. This year, button-down collars had come back when I wasn't looking. But the real name of the game was "monochrome" in any dark hue. Some of the young men looked like classic Goth in navy blue. Truly weird, but if you're bold enough and young enough, you can make just about anything work.

Tina arrived shortly after I did, and I spotted her the moment she stepped into the atrium. Unlike me, she'd heard the fashion-change signal and was suitably attired in head-to-toe dark leather. Me, I'd gotten it halfway right with my trusty, black calfskin jacket. But the soft, comfortable material was starting to show highlights at wear points on the arms and torso—*trés* chic if the fashion dice had landed on neo-Bohemian, a bit shabby by the standards of what I saw around me. Damn, I loved that jacket and didn't want to replace it.

One thing that never changed was that the women were all jacked up on three-inch heels, trolling for six-foot guys. Since I'm not a six-footer, that leaves most of them gazing across the top of my head as though I don't exist—an effective, if subtle, putdown.

Tina had bucked this trend and was wearing low-heeled black loafers. When we said hello, her eyes were right where a woman's should be. *Probably about where Jill's are*, a warning bubbled up from my subconscious, but Tina was frightening enough by herself, without unnecessary thoughts of Jill.

There is a sociological theory that says we're most strongly attracted to people we see as slightly more attractive than ourselves. It's as though we're instinctively trying to move up an invisible fraternity/sorority pecking order, but only in realistic increments. By those standards, Tina was out of my league. This morning, she'd been of the girl-next-door mold, wriggling in the grit beneath my superBeamer's dashboard. Now she was this black-leather fashion goddess. Why on earth had I let Bobby talk me into this?

Timeliness has never been Bobby's forte. He'd suggested meeting forty-five minutes before the music started, but I knew he'd be lucky to catch the first set. That left me to make getting-to-know-you conversation above a crowd babble so intense that the simple act of asking Tina if she wanted a drink forced me to lean close enough to catch a hint of one of those mind-muddling perfumes designed to convert ordinary males into stammering schoolboys. If I'd been lucky, the drink queue might then have kept me occupied for several minutes, but I caught a lull and had secured two glasses of wine within as many minutes. Meanwhile, Tina had staked out a table for four not far from the dance floor.

I never know what to say under these circumstances, so after fending off a few questions about myself and how I knew Bobby, I shifted to the safest terrain I knew: asking questions of my own. "How did you wind up as a police consultant?" I began.

A sideways glance from Tina let me know she'd spotted the evasion—surprising, because most people don't notice. Instead, they tell me I'm a great listener, which I am, because that's the best way to avoid having to say much of anything about myself. I had a suspicion that if she'd chosen to become a real cop, Tina might be a lot better in the interrogation room than I'd given her credit for this morning.

For the moment, she answered directly. "Before graduate school, I worked for a big computer company, so when I was looking for a dissertation topic, I landed pretty quickly on the idea of studying Internet subcultures. I won't bore you with details except to say that in anthropology, that's a really hot field because it's so new. And it's fun because it has

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many of the features of older cultures, all mixed into a wonderful, anarchic mess."

She took her first sip of wine, then set it back on the table. "I don't like shouting," she said. "Let's take in a few of the exhibits before the music starts." She plopped a big manila envelope on the table, with "B. Montgomery" written on it in large letters, then thought better of leaving it behind.

"Here," I said, and draped my trusty calfskin over the back of my chair. For good measure, I tipped Tina's against the table. "Bobby knows my coat. He'll find it."

Tina resumed her story on the curving staircase to the second-floor exhibits. "The biggest challenge in my Ph.D. work is the mountain of information you have to wade through." We reached the top and veered into a display of modern acrylics, where the first thing we saw was an enormous array of zigzags, like zebra stripes run amok. "Yuck," she said with a sort-of *faux* shudder. "Glad I didn't drink a whole glass of wine before viewing *that*. But to continue, genome researchers and others, especially in biostatistics, have software packages for what they call 'data mining,' which involves looking for tidbits of information in piles of data that appear random to the human eye." She gestured toward yet another kaleidoscopic image. "Kind of like looking for meaning in this stuff. Anyway, I've been applying similar tools to the Internet."

"And the police department. . . ?"

"That came in for two reasons. First, data-mining tools can be used to pursue hackers, although now you're chasing people who are deliberately covering their tracks, so it's tougher. But I've gotten a few." She brushed a strand of hair back from her eyes, conveying a quick flash of the girl-next-door Tina beneath the fashion goddess. "I'd read lots about cops before starting at the department—they're one of the most studied subcultures on the planet—but it wasn't until I nailed my first perp that I truly understood them." She gifted me with the smile that had caught my attention all those hours before. "It felt really, really good—like I'd done something truly useful and the world was a better place because of it. Academia can feel the same way, but there's not much instant gratification."

"And the other reason?"

"I needed the money." She was picking her words with care. "My family wasn't exactly supportive of my return to school. It's a long story, going back to my great-grandfather, who left Japan in the late 1920s. He'd become an American citizen and built a thriving dry goods business when the war broke out. Then they sent a lot of Japanese-Americans to Manzanar—do you know where that is? It's this awful dustbowl in the Mojave Desert. You can still find the ruins. By the time he got out, his business had evaporated and he spent the rest of his life scraping to make ends meet. It affected his son, my grandfather, even more strongly. He became obsessed with financial security—only to die young, bitter, and broke.

"That kind of thing can persist for generations. 'The sins of the father,' and all that. When I decided to go back to school, I was twenty-five, three years into a career in which a few lucky ideas can make you a lot of money, fast. And I was good enough that it might have happened. But talk about nasty subcultures—that time-is-money stuff will eat you alive. Did you notice, by the way, what a good job the spamjackers did of targeting their vics? They wanted people who'd pay up and move on, which is what I would have done in the old days." She blew out a long breath—not a sigh, but stronger, as though forcing something else out, along with the air. Then she gave a gentle laugh. "You're the only one who didn't fit the mold, but with that Beamer full of gadgets, you certainly looked like you did. I'll bet you live alone, put in a lot of time at work,

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and haven't discovered that you need to do as much of it as possible on a laptop so you're not broadcasting those work hours and all they imply over your Web server."

"Hackers can get *that*?"

"Southside had a whole rash of burglaries last month by someone who seemed to know his vics were working late."

I remembered the laptop on Bobby's desk and felt chagrinned. I'd wondered why he'd switched, when desktop units give you more computing power for the price. "Guilty as charged," I said.

"But you're not like the folks I worked with, in an all-consuming race to the top." Again, she favored me with the smile. But it faded quickly, and her eyes and voice both dropped. "Anyway, nobody gets rich from a Ph.D. in anthropology. My parents barely spoke to me that first year. Then, when I was about halfway through, my grandmother had a stroke and needed a nursing home. My folks don't have much money, but the rest of the family blames them for letting me walk away from that high-paying job. Consulting for the city was a way to help with the expenses, part-time, without getting sucked back into a career I didn't want."

We strolled in silence, transiting from postmodernism to the somber tones of the Renaissance, then the happier pastels of the Impressionists. "Now, your turn," she said. "You guard it carefully, but you carry a deep . . . sadness, I think. In some people it would show as anger, but you cover it with order. Divorce?"

I shook my head. "Never married."

"A recent break-up?"

Again I shook my head.

"Well, someone's abandoned you."

"Nobody who was ever there in the first place."

She turned away from a Renoir to face me directly. "Now *that's* a loaded comment."

Slowly, she dragged the story from me, word by grudging word. My father stumbling home drunk in the night. Promises made. Promises broken. Whispered arguments, one voice clear, the other slurred. No violence—whatever else he was, my father was a mellow drunk—but promises, promises, promises. Working a paper route to buy school clothes. Hiding my lunch money. All of this repeating over and over until Mom laid down the law and Dad went out anyway and never came back. Wondering if he was dead in a car accident or dead in a gutter, but presuming he was just plain gone.

"And then?"

Then there were feelings. Nothing surprising: Why didn't he love us? Wasn't I worth loving? Etc. Thank God for Bobby, who at least *understood,* even though we never talked about it. At that age, you don't talk about such things to anybody. Not to Mom, not to Sis, and especially not the kids at school. But Bobby and I could just *be* without having to talk, and without having to put on an act. Then Jill came along and rescued him. He was further gone than I was, but when Jill tossed him a lifeline he was smart enough to know he was lost and to give in to it completely. I'd been more like my father, never grabbing whatever lines might have been dangling in my vicinity because I couldn't risk the surrender—until putting on the act became as automatic as stoking and restoking the campfire to be sure the tigers were always kept at bay. Kind of like upgrading your spamware—something you have to do because otherwise they come at you from all directions.

I told Tina most of that, except the parts about Bobby that aren't mine to tell. I'd like to say that when I was finished, I felt relief, but what I felt was tired. There were indeed tigers circling the fire, and for the first time in years I'd nearly let them reach me. Yet, amazingly, I was still alive and mostly functional. Equally amazingly, Tina didn't find an excuse to leave. Instead, she gave me the gentlest of touches on the elbow and

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steered me into the next exhibit hall.

A few minutes later, we fetched up in front of an enormous Bierstadt painting of a romanticized mountain range awash in golden light—a fantasy based on a nearby location I'd visited many times.

"Look at that," Tina said. "He put in the river and the waterfall and all the big peaks, and everything else he could think of. Who cares if there's no place where you can actually see it all at once? He just let it all wash over him—gave himself up to the beauty—and produced *this*."

She caught the dubious expression on my face and her chuckle danced in the marble echo chamber of the exhibit hall. "I'll concede that the painting might be a bit overstated. Well, more than a bit. But Bierstadt knew something I had to learn the hard way." Her eyes were on the painting, but her hand was in mine, and I wasn't sure how it had gotten there. "You have to let life wash over you in all its confusion and uncertainty, or you wind up cramped and small, like my grandfather. Yes, his father was unfairly treated. Yes, it still makes me angry to think about it. But it makes me even angrier that grandfather then let them steal his soul along with everything else." She gave my hand a brief squeeze. "Don't let your father do the same to you. He's not worth it."

The tigers were prowling again, nearer than ever. So far they'd just had a sniff at me, but she was urging me to let them drool all over me. "Wow," I said, to keep them at bay a tiny bit longer. "You should've been a preacher."

She shot me another of those looks, but knew when to back down. "That's my brother," she said. "I wasn't the first in the family to stray from the path to riches."

She paused, considering whether to press her point one step further. But she was obviously a person who'd rather fail by trying than by not attempting. "It took him three years to convince me that time is more than money," she said quietly. "You don't have to be alone." Her tone lightened and with a final squeeze, she released my hand. "Speaking of which, let's go find your friends."

The music was starting by the time we got back to the table, and Bobby and Jill were there, sitting as close together as the straight-backed chairs allowed.

Bobby gave me a nonchalant wave. "Figured you'd be back eventually," he said cheerily. He stuck out a hand to Tina. "You must be the soon-to-be-doctor Nakamura."

"Not soon enough," she smiled in return. She slid her envelope across the table, and Bobby was starting to open it when Jill laid her hand gently on his. When he glanced her way, she mouthed something that looked like "not now" and cocked her head almost imperceptibly my direction.

There are occasions when nonverbal signals pass between those two with the speed of computer chatter over high-speed lines. Bobby shoved the envelope back toward the center of the table. "Business later, dancing now," he pronounced, and turned to his wife. "May I have the honor?"

Her assent was light, sweet, and aimed at Bobby, but her eyes were on me—assessing, probing, and briefly mixed with something that might have been frustration, or worry.

If Tina caught this, she chose to pretend otherwise. Instead, she slid her chair around the table in my direction—whether to get closer to me or for a better view of the band, I wasn't sure. Then the band swung into a lively tune and for the next few minutes conversation was difficult.

In front of us, Jill dipped low as Bobby twirled her about the dance floor. He was good at showing her off, and she basked in it. Watching them, I was finally ready to face one tiger—asking myself what it was that I really, secretly thought of Jill.

The answer was a surprise. Of course,

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I loved her. I always had. But not that way. There was no secret attraction. I loved her dearly, partly because she was my second-oldest friend, but more for her love of Bobby. One without the other was as unimaginable as half of the couple now flowing so easily among the other dancers.

Tina leaned close, cupping a hand to my ear. "They make a nice pair, don't they?"

I nodded, startled by how easily she'd seemed to have read my mind. Or maybe she was just following my gaze. "They always have." And finally, the dream made sense. The blonde may have looked like Jill, but she hadn't *been* Jill. She'd been the *concept* of Jill. What I wanted, with a longing so carefully papered over that it was hard to recognize without the emotional data-mining I'd been avoiding all day, was a woman who could rescue me as Jill had rescued Bobby. No, that wasn't right. I *wanted* to want it, which wasn't quite the same thing.

Tina again leaned close, the scent of her perfume making my heart race with a desperate mix of fear and longing. "Are you going to ask me to dance?"

Without a prompt like that, I probably wouldn't have. I've never been much of a dancer.

"It's okay," she said cryptically. Then, with a hint that she might really have mind-reading potential, she added, "Besides, all eyes are going to be on those two, not us."

The rest of the evening was a blur. We danced, we finished our wine, we found hors d'oeuvres, we talked during the set break but not about spam, and when the band started back up, it was Bobby who met my gaze, although this time the mix of expressions was unreadable. Eventually we spilled onto the street, the B. Montgomery envelope still unopened. Dinner came next, then a couple of more drinks—something I usually avoid for fear that alcoholism runs in my blood.

Finally, Bobby opened his envelope and we sort-of got down to business.

The envelope contained my autodrive download, which was the only one Tina was allowed to give him. Even then there was a consent form for me to sign. One side-effect of spam is that the more the hackers prove that nothing is safe, the more privacy-conscious the government becomes. It's as if the bureaucrats constantly need to remind us it's not their fault. Tina herself was free to talk about anything she wanted, so long as it wasn't too specifically related to individual vics. Bobby offered her a job on the spot, but she surprised him by hesitating.

"Look," he said finally. "Is there some reason you don't *want* to make money?" Then he proved that two can play the mind-reading game, or maybe that he'd been doing other homework during part of the time when he'd supposedly been finishing his afternoon project. "I don't run a sweatshop like your former employers," he said. "I do this because it's fun,"—he glanced at Jill—"and it allows me to spend all day with my wife, and"—he paused slightly—"helps make up for a few things. You name your hours, I'll name your pay, and by all means finish up that Ph.D. and become the best damn anthropologist you can."

Bobby's stubborn, but Tina held her own against him and it ended in the stalemate of "maybe."

Which is pretty much all the business we managed to get done that evening, because there really was more wine than I'm used to—enough that switching the autodrive back on for the ride home seemed like a good idea, even if it wasn't hack-proof.

If I have one glass of wine, I sleep soundly. With more than that, my sleep can be fitful. I've never been tempted to pursue it far enough to discover whatever stupor it was that my father always drank himself into.

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That night, I had a jumbled dream in which somebody I couldn't see chased Tina with a bag of tiny purple berries, throwing them at her in handfuls that turned into winged Dad-faces and flew away. Tina got tired and quit running, and Jill and Bobby and I tried to guard her from the berries by swatting them away. But they no longer flew, and instead fell around her in Dad-faces and Jill-faces and everybody-else's faces, where they piled higher and higher until nobody could find her. Then Tina laughed like tinkling bells in a marble hallway and said it's okay, she was still there, and there weren't any other Tinas, so she just needed us to quit swatting and open a berry mine—

—and then Hal, who I'd meant to replace with a wind-up alarm clock, was blaring in my ear with a huge hash of spam and his programmed routine. "Good . . . berry . . . Dave . . . mortgage . . . slept well . . . bust size . . . hiding from you . . . consolidate your . . . traffic report . . ." The gibberish mounted, then degenerated into white noise as spammer after spammer joined the chorus—

—and then it no longer mattered because suddenly I had the answer, and Tina was more right than she'd ever have believed, because it really didn't involve running away.

I called Tina first, then Bobby. Tina was excited, Bobby more dubious—which wasn't surprising, because this was more her field than his—although she was later to admit that she had the easy job of brainstorming ideas for Bobby, then burying herself in her Ph.D. work while he struggled to execute them.

But within days, Pipsqueak Systems, with Tina as a very part-time consultant, set to work on two products. The first, marketed through a well-known spamware provider, was a temporary patch against the berry folks' innovations. Bobby didn't think it would last more than three months, but by this time berry ads were popping up everywhere, and the spamware provider was thrilled to be the first to be able even to slow the onslaught.

The second product was the one that was my own brainstorm. Jill set up a puppet firm to handle the licensing because if it worked, it would be so revolutionary that for once, she wanted full control. Our goal was nothing less than giving people back their lives, and none of us wanted the price jacked through the roof.

The program is based on Tina's data-mining routines, run in reverse. Bobby has a fancy name for it, but I prefer to think of it as surrendering to the tigers.

In traditional data mining, you're looking for order amid chaos, with an implicit presumption that the order is the good stuff. Conventional spamware tries to preserve the order by blocking out as much of the chaos as possible. But suppose you open the floodgates and let the spam flow, unimpeded. It's counterintuitive because we all know you'd be instantly buried in junk—as indeed you are. But those buy, buy, buy messages are a form of order, and my idea was to let them all in so that Tina's data-miners could see the order and discard *it* to find the residual chaos—that single message from Sis among the deluge of ads.

Our first real test was with Hal. Bobby said it was because he's a simple system, but Bobby can be sentimental and we both liked the idea of returning to where it had all begun. While Bobby was writing and rewriting code, I became increasingly nervous—what if my brainstorm proved a dud?—but Bobby was his usual chipper self. "It'll either work or it won't," he said. Other than that, the only things you could drag out of him were variants on the word "interesting." But late one afternoon, when even Bobby was beginning to look haggard, I took the clock to his office.

It was hard not to think of Hal as being surprised when I programmed him for 6 P.M., but, well, he's a clock, and sur-

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prise isn't in his repertoire. Neither, in a minor lapse on the part of his designers, was "Good evening, Dave." Still, he clicked to life at the appointed hour, instantly producing white noise from what Bobby's monitor counted as 1,393 separate spams the moment he tried to log onto the weather and traffic websites.

Then the white noise segued to chop as the data-mining algorithm kicked in, until a few seconds later, Hal's dulcet tones were giving us the tail end of a perfectly coherent traffic report.

I was frowning, but Bobby was ecstatic. "It's a learning program," he said. "It'll get better—and for the moment we can just throw in a short delay before it starts speaking. Not the most elegant approach, but good enough for a clock." He busied himself in his laptop, connected to a spaghetti-bowl of wires hanging off Hal's backside.

We reset Hal for 6:30. This time, he woke up at 6:29, and again registered something better than 1,000 hits the moment he logged on. Nothing else happened for what felt like an eternity, until, at precisely 6:30, something ticked over in Bobby's modified software and Hal calmly asked if I'd had a good night's sleep.

Tina had been standing next to me through the entire experiment. "Way to go, Bobby!" she cheered, but it was me she hugged. "Pretty good concept, too," she added to me, *sotto voce*. "Not bad for a tech writer who claims not to know much about computers."

It was merely the first step, but Bobby was already confident he could adapt his program for e-mail. Voice mail would be a tougher nut, but in both cases, the key lies in developing hardware modules that scroll through the mail queues, looking for the "noise" behind the spam's counterfeit order. Just to be on the safe side, these programs won't erase suspect spam; they'll just rank-order the mail so you can start with the most important stuff and read as far as you want. Ironically, the more spam you get, the more accurate the rankings should be. That smartest advertisers might still get through with limited, well-focused mailings, but that's not the wholesale junk we're trying to get rid of, anyway.

Since it was again a Tuesday, we found ourselves back at the art museum for another concert. In the intervening weeks, I'd seen Tina often, but always at Bobby's office, always in settings where I could bury myself in the spam project and not have to think much about the rest of my life—other than to realize that someday, I really should ask for that raise.

Again, Bobby and Jill were among the first couples to take to the dance floor, and again, Jill's gaze met mine. Only this time, I'd swear she *winked*.

Beside me, Tina—the enchanting presence from which I just might be ready to quit fleeing—was waiting for me to ask her to dance. I really don't like putting myself on display that way, and probably never will, but at least I was able to do it this time without the strong nudge from her. And when we finally joined the other dancers, I realized that Tina had been wrong about something all those weeks ago. All eyes weren't on Bobby and Jill.

One set had no interest in anyone but her. □

What doesn't kill you, makes you sore.

—Jerry Oltion

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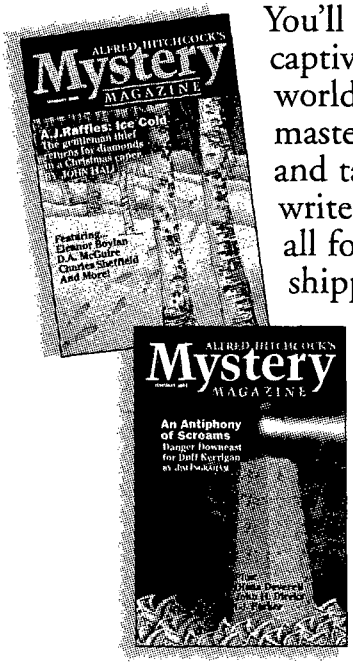

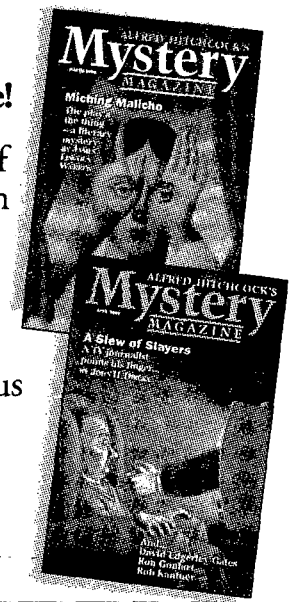

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Guardian, Joe Haldeman, Ace, $22.95, 231 pp. (ISBN: 0-441-00977-8).

The Earthborn, Paul Collins, TOR, $23.95, 240 pp. (ISBN: 0-765-30307-8).

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A New Dawn: The Complete Don A. Stuart Stories, John W. Campbell, Jr., James A. Mann, ed., NESFA Press (P. O. Box 809, Framingham, MA 01701), $26, 462 pp. (ISBN: 1-886778-15-9).

The Science Fiction Hall of Fame, Volume One, 1929-1964, Robert Silverberg, ed., TOR, $27.95, 560 + xvi pp. (ISBN: 0-765-30536-4).

SETI 2020: A Roadmap for the Search for Extraterrestrial Intelligence, Ronald D. Ekers, D. Kent Cullers, John Billingham, and Louis K. Scheffer, eds., SETI Press, $25, 549 + 1 pp. (ISBN: 0-9666335-3-9); order at www.seti.org.

The Future of Ideas: The Fate of the Commons in a Connected World, Lawrence Lessig, Vintage, $15, 352 + xxiv pp. (ISBN: 0-375-72644-6).

Because of the nature of this magazine and its publishing mechanics, I write these reviews about six months before you see them and eight months before the date on the cover. (I'm starting this September column in January!) The books I review have been awaiting my attention for weeks and sometimes months. Some of these books are bound galleys, which will be published in the next month or so. Some are hardbounds and paperbacks that were published a month or so ago. In both cases, my reviews appear long after the book has vanished from the shelves, though you may still be able to have your bookstore order it (or you can order online—Amazon.com is just one of many sites—often at a discount).

To defeat this problem at least some of the time, I have long invited writers to send me manuscripts—either on paper or electronically, which these days usually means via email (Word's .doc format works fine; Mac users should save as .rtf or .txt; when in doubt, use .rtf or .txt).

I hereby renew that invitation, though you should check with me before sending manuscripts via email. (Necessary contact information is in the SFWA Directory.) But do be warned: I'm usually fairly positive about what I cover, but some writers have regretted sending me their books. Fortunately, there are many reviewers out there, and they are rarely unanimous in their opinions.

Most reviewers seem to be on the Web. Most of those are pretty amateurish, but there are a few sites with reviewers worth a look. One such site is SFReader.com, which is gaining readership as I write; pay particular attention to a certain new and savage reviewer who thinks that I was much too easy on, for instance, Orson Scott Card's latest.

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* * *

Scott Westerfeld's Risen Empire is an interesting and appalling place. Sixteen centuries past, a researcher conquered death by finding a way to reanimate the dead with a synthetic "symbiant." Immortality was at last achieved, the researcher committed suicide so he could be the first, and he then built a realm of eighty worlds, the Empire, in which the rich and powerful are rewarded with the symbiant. The living are prosperous enough, but society is dominated by the past and the hope of life eternal.

Of course, folks are still human. There is dissent, with the "Secularist" political party holding that people should not accept the symbiant. Die, they say. Let go, so the future can live.

There are also the Rix. They are external to the Empire, but they have melded flesh and machine and they hold holy the artificial intelligences that can emerge from planetary infonets, if they are not stopped. Since this is anathema to the Empire, one of their grand objectives is to seed minds in the Empire's worlds.

And so begins **The Risen Empire: Book One of Succession**. The Rix have attacked Legis XV, seeded a mind that knows who its friends are, and taken hostages, including the Child Empress, the Emperor's sister and a beloved icon of the Empire. Empire forces commanded by Laurent Zai are counterattacking, using remotely piloted, gnat-sized microships to locate and target the foe. Alas, they fail, and Zai receives the Imperial order: he must fall upon his blade.

Fortunately for him, his lover is Nara Oxham, Secularist senator, just appointed by the Emperor to the War Council. She gets a hurried message to him, telling him to live. The Emperor soon learns of Zai's defiance of holy tradition and holier command and orders Zai and his ship into a suicide mission.

Is there hope? Westerfeld ends the book before the crux, but Zai is competent and this is a series, after all. Even if he dies, there are plenty of unanswered questions to keep the tale going: What are the Rix really after? Are they really so inhuman? Are artificially intelligent planets and houses so awful? And what was the mysterious object buried in the Child Empress's body?

And where is the series going? The series title (*Succession*) can be taken to mean at least three things: rebellion, with the removal of one Emperor and the ascension of another; a Rix victory and the domination of the Empire's worlds by planetary minds; and a more gradual or partial ascension of artificial intelligences (think of ecological succession). It will be interesting to see where Westerfeld is going, and it will not be hard to follow along. His sense of social structure and technology is masterful, his characters are well drawn and appealing, and his plot has all the momentum you can ask.

Enjoy!

You can see another take on emergent artificial intelligence in Michael Flynn's **The Wreck of the River of Stars**, a prolonged character study focused on a spaceship in a jam. The ship is the *River of Stars*, once a luxury sailing ship (the sail was a loop of superconducting cable that pulled thrust from the solar wind) downgraded to tramp freighter by the advent of fusion engines. Officially, it's a hybrid craft. The mast is still in place, and the sailing gear is still in storage. But fusion is the thing these days.

Unfortunately, hauling freight works better in a ship optimized for the task. The *River* is a pretty marginal operation. Fortunately, it has a good captain in Evan Hand, who has a knack for recruiting misfits with pasts, problems, and attitudes in addition to essential skills. Unfortunately, Hand dies on page 4. Two of the four fusion drives break down. A rock slams into the ship.

What to do? Gorgas makes a pretty ineffectual replacement for captain, much

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preferring his war-gaming. Corrigan is a navigator of little initiative or imagination. Bhatterji is a pig-headed engineer whose lecherous yearnings complicate his relationships. The Lotus Jewel, computer specialist, is a flirt.

Bhatterji dives into the repairs with a will, but the old sailing hands—who fondly recall the days when sailors enjoyed high status—decide it would be a good idea to run out the sails and come to port in the old and glorious fashion. Alas, there is conflict over resources. Meanwhile, the AI, Rivvy, is going a bit wonky, "autoinitiating" and, to everyone's surprise, developing what looks suspiciously like a mind and a will of its own.

The ship is doomed, of course. The people—including the AI—may be as well, but the point of the tale is less that doom than it is their characters, their natures, and how those natures create, maintain, and worsen the crisis. The book is therefore a prolonged character study. If you want more action, it may be far too prolonged, to the point of obsessive navel-gazing. It will suit you better if you think character is as important as (or more important than) plot and event, for Flynn is deft and witty in his analyses. If you remain less than entirely satisfied, that may be because Flynn seems to have found it difficult to maintain perfect consistency.

The take on emergent artificial intelligence? Rivvy is normal at first, but its neural nets are getting anomalous inputs from a crew of anomalous misfits. Since neural nets adjust themselves, it edges closer and closer to something like consciousness until it too can contribute to the ongoing crisis. Yet Flynn is not suggesting that a conscious AI is a bad idea. Rather, Rivvy is a child, with a child's biased willfulness. In a more benign setting, Rivvy might have had a chance at maturity and nobility.

Joe Haldeman has long been one of our more thoughtful and interesting writers. A new book is therefore not to be ignored, and when **Guardian** showed up in the mail I was quite happy to sit down with it.

And I was not disappointed. The tale purports to be offered by Blake Coleman as a memoir written by his grandmother, Rosa Coleman, toward the end of her life. She was born in 1858, went to Wellesley, became a writer of pulp SF and more, and died in the 1950s. That alone might seem to be enough for an interesting read, but Rosa's life took some strange turns. While at Wellesley, she met a charming man who wooed her, won her, and promptly proved to be the kind of monster who thinks wives and children are property to be abused. When Rosa sees him buggering their son Daniel, that's it. She packs and is about to leave with the boy when a raven appears to quoth, "No. Gold."

So she delays long enough to fetch from the bank the cache of gold coins left her by her late father. And then they are off, crossing the country by train and steamboat until they reach Dodge, where they settle for awhile. She becomes a teacher, and Daniel grows up and enlists in the Army for the Spanish-American War. But the enlistment catches Daddy's eye, and they must flee again—seen off by the same raven, uttering the same words.

Next stop, the Pacific Northwest and a ship heading north to Alaska and the gold-rush territory. They meet the Colemans, father and son, Daniel catches the gold fever, and Rosa finds something that looks and feels a lot like love. The raven appears again, and in due time Rosa returns to teaching while she waits for Daniel and her lover, with or without the fortunes they seek.

Not that things always work out as we expect them. Rosa has fled one tragedy, tasted happiness, and fled again, and perhaps another tragedy lies in wait. But so does the raven, with more words this time, as well as a journey through the cosmos, lessons, and a choice of des-

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tinies.

Masterfully done, a genuine pleasure, and Rosa is one of those characters you wish you knew in person.

I commend this one to you highly.

Paul Collins's **The Earthborn** is dreary, conventional, and trite. Years ago, the *Colony* departed Earth for Tau Ceti, aiming to establish a colony. However, the carefully selected corps of colonists was displaced by a horde of moneyed thugs. When Earth erupted in war and then fell silent, and when Tau Ceti proved to have no worlds worth settling, they decided to turn homeward and re-create civilization in their own nasty image. Dissenters, smart-ass kids, and their associates were declared defective and banished to the lower decks.

As the moment of landing looms near, fourteen-year-old Welkin Roberts sees a friend so banished. Soon, as an associate, he is hauled in for questioning and offered a chance for redemption: He will be in the initial exploratory party.

Fortunately, he survives the attack by cannibal savages and bumps into Sarah, who seems a lone voice of reason, remarkably knowledgeable about the past and busily plotting to create a rather more civil civilization than *Colony*'s elders have in mind. In due time, Welkin realizes who the bad guys are and signs on. Vastly outnumbered and outgunned, they somehow survive and actually seem to have a chance of prevailing.

But it's an idiot plot, made so by its continual violations of the Rules for a Successful Evil Overlord (which boil down to never giving a sucker an even break; see http://www.ficara.net/funnies/emperor.html).

Not recommended.

I wasn't sure that F. Paul Wilson's **Sims** was worth much attention when I started reading. The setup seemed familiar, even trite: A spoiled labor lawyer, Patrick Sullivan, out for Numero Uno above all, sights set firmly on a partnership in the firm, is playing golf at a country club. The club won't have him, but oh, how he craves membership and the access to moneyed potential clients that would mean.

So, golf, and a ball in the rough, and when he asks for the five wood, the caddy tugs his shaggy forelock and says, "Seven better, sir." Really? "Nabb watch Mist Sulliman before."

It's that ol' plantation Yassa, Massah up for grabs again, only this time the "niggers" aren't aliens or robots. They're sims, genetically engineered chimpanzees, declared "property" by Congress, cloned by the zillions by SimGen, and leased out as grunt labor all over the world. They're deliberately sterile, and they're supposed to be stupid. In fact, if they learn to read, they're "recalled."

Unionizing sims looks like a fool's errand, but before long, Patrick's home has been firebombed and he's been run off the road and attacked by murderers. It's clear that something strange is going on, and he's not alone in wanting to do something about it. Meet the lovely Romy Cadman of the Federal Office for the Protection of Research Risks, who wants to know what's going on inside SimGen. Meet the mysterious Zero, who *always* wears a mask and is busily scheming to bring SimGen down.

Now meet the evil Luca Portero, SimGen's chief of security, whom Wilson tells us early on was assigned to SimGen, without giving any hint about who might have the power to do such a thing. Sounds like a conspiracy? Wheels within wheels? No kidding! But here's where Wilson escapes precedent and becomes well worth the reading: As soon as Meerm, a sim abused by a not-too-fussy human, turns up pregnant, those wheels really begin to spin. Since biologists use interbreeding as the definitive test of whether two critters belong to the same species, this has the potential to bring down the temple. SimGen's foes know that, but so does Portero, who will stop at nothing in the service

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of his masters.

Have fun!

The New England Science Fiction Association (NESFA) continues its proud tradition of bringing neglected classics back into print with **A New Dawn: The Complete Don A. Stuart Stories**. "Don A. Stuart" was the name John W. Campbell, Jr., derived from his first wife's name (Dona Stuart) and used when he shifted away from his early stories involving "rocketry and interstellar collisions." The new stories put form above function and mood above action, and they were enormously novel for the time.

Not now, of course. As Stuart, Campbell shook things up and started a trend that never faltered. Campbell himself faltered, to be sure, when he fell into the swamps of dianetics and Dean drives, but the trend kept rolling and today its fruit are to be seen everywhere.

Want to see where it started? This book has it all, from "Twilight" (1934) to "Who Goes There?" (1938), which became the classic SF movie *The Thing* and its remake, and fifteen more. All appeared in *Astounding*, a few even after he became editor in 1937, or its companion *Unknown*. Add an introduction by Barry N. Malzberg, who notes that Campbell's "duality [as rationalist and mystic] was profound" and responsible for both his success and his later decline, and you have a valuable book for any student of the genre. Add an essay on writing, "Wouldst Write, Wee One?" (which appeared in a fanzine called, of all things, *Scienti-Snaps*, and urged would-be writers to build civilizations before they build stories), and how can you lose?

Want to do a good deed for a local school or town library? Hook a child on SF? (Hey, Christmas isn't *that* far off!) Buy a copy of **The Science Fiction Hall of Fame, Volume One, 1929-1964**, just reissued by TOR. Its twenty-six seminal stories, chosen by the vote of the members of the Science Fiction and Fantasy Writers of America, bear the names of the stars of classic science fiction and titles all long-time readers recall with love and awe. Here is Weinbaum's "A Martian Odyssey," Heinlein's "The Roads Must Roll," Padgett's "Mimsy Were the Borogoves," Leinster's "First Contact," Cordwainer Smith's "Scanners Live in Vain," Matheson's "Born of Man and Woman," Blish's "Surface Tension," Bester's "Fondly Fahrenheit," Keyes's "Flowers for Algernon" . . . You get the idea.

I know a couple of young boys to give this one to—but I'll have to buy one for them. I'm keeping my review copy.

SETI 2020: A Roadmap for the Search for Extraterrestrial Intelligence is the report of the Search for Extraterrestrial Intelligence (SETI) Science and Technology Working Group, which between 1997 and 1999 developed a plan for the SETI effort through 2020, which will center on multi-antenna arrays, improved multi-channel scanning, and initial efforts to look for infrared and optical signals. The book provides plentiful details, as well as a brief survey of SETI history, the science that backs up the idea that SETI is worth attempting, and the technology that makes SETI even remotely possible. About half the book is the appendices, which address the feasibility of beacons, the Fermi paradox, past searches, and much more.

If you're interested in SETI—and it's a reasonable bet that *Analog* readers are!—you will find this one fascinating.

In September 2001, I discussed Lawrence Lessig's *Code and Other Laws of Cyberspace*, saying that its theme was the changing nature of the online world, whose roots are the sort of anarchic free speech the campuses of the 60s were renowned for, but whose future is as button-down as an accountant's spreadsheet. Lessig was worrying that there

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were forces at work that could strip cybernauts of their accustomed freedoms and thereby work to the detriment of us all. Now, he says, his fears have already come truer than he ever dreamed.

In **The Future of Ideas: The Fate of the Commons in a Connected World**, Lessig discusses the vast importance to freedom, economics, and innovation of resources owned and used in common, and the damage that can be done when resources are locked up in private vaults. He does not argue against private ownership, but for balance, showing, for instance, that when AT&T had an armlock on telecommunications, it stifled innovation despite Bell Labs' sparkling reputation. (Anyone remember the Hush-a-Phone?). After the Bell Break-Up, telecom innovation flourished as never before.

One major threat today lies in the legal protections given the corporate owners of intellectual property, to the point where film-makers, for instance, must gain permission and/or pay fees to include any recognizable product in their works. Film thus becomes an enterprise for the wealthy, not the art student, and innovation vanishes. Software and web technologies are hamstrung in similar ways, and this is of course his focus, for Lessig is a scholar of the cyberrealm.

We are ruled, he tells us, by judges and lobbyists, and the Internet's architecture of innovation is being abandoned, without most people even noticing, in favor of an architecture of control. What's more, he wrote in his preface, he was afraid that his book would seem quaintly and rosily optimistic by the time it hit the bookstores. Since he finished the book before September 11, 2001, and the ensuing rush to surveillance, he was surely right. Yet, he says, though we may be "failing that ideal [of balance] just now . . . we need not fail if principle—not politics—defines the fight." ■

IN TIMES TO COME

Our October issue features a rare treat: a new novella by Vernor Vinge, well known to *Analog* readers for his elastic and far-ranging imagination. This one is about some folks with a problem Sisyphus could empathize with—and what they do about it gives new meaning to "time-binding"! We'll also have a variety of fiction including a clearly seasonal piece by Brian Plante and one that might or might not be considered seasonal by Robert R. Chase—and, of course, Part 3 of Edward M. Lerner's four-part *Moonstruck*.

The science fact article comes from a trio of authors either well known to our readers or likely soon to become so: Robert A. Metzger, Gregory Benford, and Martin I. Hoffert. Under the somewhat unlikely title "The Power of Rotting Plants, or How SF Solved Global Warming," it offers an imaginative new approach to that much-publicized problem, intriguing in its own right and a worthy follow-on to Richard A. Lovett's recent article about other possible methods.

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BRASS TACKS

Reading Steve Leibson's letter, and author Edward Lerner's response regarding computer viruses in his story "Survival Instinct" started setting off metaphorical alarm bells in my head. As I write this, we are a few weeks past the successful late-January deployment (as it were) of Sapphire, the first so-called Warhol worm, one which propagates so fast that it could infect essentially the whole Internet within on the order of 15 minutes.

Leibson seems to have forgotten the earliest widescale Internet worm, the Morris worm. It was targeted at and successful at penetrating both Sun-3 and VAX systems, then the most prevalent hardware architectures on the Internet, through a poorly documented diagnostics backdoor in the Sendmail email transfer software. That virus and worm writers since have been lazier than Morris and not attempted such cross platform attacks doesn't mean that such are not possible in the future. Security experts are warning that such multi-target worms are a major future risk. Worms with the code to attack and infect multiple operating systems and able to exploit multiple security holes are possible. One is tempted to guess that this may mark a distinction between amateur grade and military grade computer network warfare.

Both Leibson and Lerner seem somewhat ignorant of the state of the art of embedded systems. Embedded systems are commonly running with the sort of CPU and RAM that were workstation to server class when Morris' worm ran rampant. They also often include nonvolatile FLASH RAM to store their operating system, which could conceivably be overwritten during system operation (though usually it requires a write enable jumper to be put in place, or something equivalent). Some are including hard drives as well, along with music and video systems.

Those embedded systems are not running a monoclonal operating system or hardware environment as Lerner indicates, nor is there any indication that there is likely to be a convergence as he predicts. Intel desktop class CPUs are relatively rare in embedded applications, and in midrange and larger servers (despite Intel's marketing hype quoted by Lerner), and Windows is not as Lerner asserts taking any significant fraction of the embedded operating system market. This makes the multiplatform worm or virus writers job harder, but not impossible.

Java, and similar multi-client-system languages, offer another possible vector for worms and viruses. Though Java has been written to attempt to tightly constrain such attempts, it is possible that intrusions via other mechanisms could then run common cross-platform Java code to execute their main operations.

I would like to close with an observation related to the Sapphire worm which I mentioned at the beginning. This worm, though it was limited to a single environment (Windows systems with unpatched SQL Server), propagated to most if not virtually all of the systems which were vulnerable to it in short order, and then proceeded to swamp the Internet routing infrastructure with its ongoing infection attempts. The lesson from Sapphire is that sometimes, even just targeting one limited set of systems is "good enough". A hypothetical AI propagating like a worm, which only knows how to "infect" x86 processors running Windows, is going to find a fertile environment to grow into.

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George William Herbert

The author replies . . .

I'm pleased the computing infrastructure behind "Survival Instinct" is sufficiently interesting to elicit such reader comment. I find myself wondering, however, if this Brass Tacks dialogue isn't diverging far from the story.

Mr. Liebson first raised the question whether any computing platform (processor plus operating system) is sufficiently prevalent to make the escaped-and-angry artificial life a threat. In the March issue, I answered that specific question: yes, given the marketplace dominance of a very few chip families and operating systems. Wintel empire isn't the only possible marketplace outcome, but it is (I believe) surely a plausible one. Isn't plausible extrapolation the standard for an SF story?

Mr. Herbert wrote not about "Survival Instinct" itself, but rather about my response to Mr. Liebson. Herbert points out, and I agree, that precedent exists for cross-platform worms.

Might the vulnerabilities my artificial life exploits be specific to a hardware/software platform, as Mr. Liebson would require? Yes, and that would be (I believe) a plausible extrapolation.

(Mr. Herbert correctly states that only platform popularity, not ubiquity, is necessary for the AL to wreak havoc. He thereby addresses his own comment about embedded vs. server and workstation computers. If he does not find credible AL attack of embedded-processor devices, he can choose to believe the AL's havoc is wreaked only through more vulnerable classes of machines. (As noted in my March comments, "Survival Instinct" has no explicit mention of the AL attacking any embedded-computing device.)

Or . . . *might* the vulnerabilities be cross-platform, as Mr. Herbert proposes, such as a security hole in the Java runtime environment? Yes, they could.

Or . . . *might* the AL be so advanced that it can find and exploit different vulnerabilities on different platforms? The classes of problems it is seen to solve are sufficiently challenging that (I'll assert) that, too, is a consistent answer.

My concept for "Survival Instinct" required lots of detail (albeit speculative and extrapolative) about artificial life and how it could evolve . . . a level I thought already requested much reader forbearance. I didn't think the specific vulnerability mechanism was central to the story, or worth additional digression/exposition. So by which of these mechanisms *did* the creature attack? The story simply does not say.

This isn't to say that, over beers at a con, I wouldn't love debating the possible explanations . . .

Dear Dr. Schmidt;

I am writing in support of Steve Leibson's letter (Analog, March 2003) concerning Edward M. Lerner's "Survival Instinct" (Analog, October 2002). I found my "willing suspension of disbelief" strained well beyond the breaking point.

Mr. Lerner claims that all that is left in the marketplace are Linux and Windows. Well, that doesn't reflect what I see in the field.

In addition to Linux, there are a lot of real Unix and Unix-like systems out there other than Linux. The *bsd systems still have a solid presence in the server field, as do IBM's AIX and SUN's Solaris. Some of the remaining "supercomputer" manufacturers seem to be using proprietary flavors of Unix as well. Further, these are running on chips such as POWER and SPARC that are totally incompatible with the Intel architecture.

The midsize and large servers also look very different from what the author portrays. There are a lot of AS/400 systems out there, running OS/300, and a lot of 9672 and z/900 systems running z/VM and z/OS. The work running on z/OS, in particular, tends to be the mission critical, bread-and-butter, heavy duty work.

Samuel Clemens once wrote that the claims of his death were greatly exaggerated. The same could be said of the non-IBM mainframes. Unisys still makes the

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old Burroughs B6500 and UNIVAC 1108 lines, under different names. B.U.L.L. still makes the Honeywell line.

A lot of the Internet and LAN traffic is handled by Cisco hardware. Whatever vulnerabilities their software may have, they are not the same vulnerabilities as Linux and Windows.

We may or may not be moving to the monoculture that Mr. Lerner claims, but we aren't near it yet. Without such a monoculture, the story lacks plausibility, and even with it there is a lack of credibility. Most of the worm and virus attacks that I have read about have depended on sloppy security, and while a lot, or even the majority, of shops maybe poorly run, it does not seem likely that all of them are.

The hardest part to swallow, however, was having the intelligence move from machine to machine instead of replicating from machine to machine. There should have been a lot of malevolent AI systems to contend with, all over the country, rather than a single intelligence shuttling around. Of course, given a realistic description of propagation, the plot gimmick of a dead end wouldn't have worked.

Shmuel (Seymour J.) Metz

The author replies . . .

Mr. Metz endorses objections of an earlier letter—that no computing platform is ubiquitous, and that Internet routers aren't Windows+Intel boxes. Both statements are true; neither refutes the premise of "Survival Instinct."

Total platform standardization is unnecessary for the artificial-life (AL) entity to wreak havoc. Using 2002 sales data (although an SF story should be allowed to extrapolate an obvious trend!), Windows has >80% market share on the desktop and ~50% market share among servers. A threat to "only" that much of the computing world is quite scary to me. How long would it take to replace that many computers with an also-ran hardware/software platform—assuming the infrastructure to produce them remained viable—even if the AL were incapable of adapting?

Of course it *can* adapt—it is far more complex and capable than a conventional (and unable to learn new tricks) worm or virus. The "Survival Instinct" entity solved mazes of up to thirty dimensions. It derived and learned operating-system calls not within its original programming. To escape the computer on which it was bred it deduced by trial and error the details of networking protocols (in Internet-speak, TCP/IP). To escape the lab, it circumvented a security gateway. One "under the hood" implication of defeating security gateways is that it can hack encryption systems, on which inter-computer authentication exchanges and secure protocols rely. (Cracking many modern codes requires only the ability to efficiently factor large numbers into primes—the type of problem-solving at which the entity excels.) In short, the abilities the creature needed to evolve and survive would *easily* enable it to also learn and adapt to a new instruction set (for non-Intel hardware) and/or new system calls (for a non-Windows operating system).

And routers? After deriving the rules of TCP/IP, the AL can move as transparently *through* routers as any streaming video or music download. The AL is never said to have occupied a router.

Mr. Metz also characterizes as an unsatisfying plot convenience that the AL fails to replicate like a common computer virus. It *isn't* a virus. Thousands of generations of 1-in-100 selections produced it. Replicates, it has learned, are its competitors. It has an inbred aversion to replication. (In fact [see October, page 42] it intentionally disabled the compromised experiment's replication feature to preempt the creation of new rivals.)

"Survival Instinct," more than a title, is *the* central characteristic of the evolved entity. The AL's ability to solve new problems, and its aversion to creating new competitors for itself, are equally consistent consequences. □

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UPCOMING EVENTS Anthony Lewis

28 August–1 September 2003
TORCON 3 (61st World Science Fiction Convention) at Metro Toronto Convention Centre, Royal York Hotel (and others), Toronto, Ontario, Canada. Guests of Honor: George R.R. Martin, Frank Kelly Freas, Mike Glyer. GoHst of Honor: Robert Bloch. TM: Spider Robinson. Registration: Attending CAD250 /USD170, Supporting CAD60/USD40, Child CAD60/USD40. This is the SF universe's annual get-together. Professionals and readers from all over the world will be in attendance. Talks, panels, films, fancy dress competition—the works. Info: Torcon 3, Box 3, Station A, Toronto, Ontario M5W 1A2, Canada; info@torcon3.on.ca; www.torcon3.on.ca [Note to US readers: first class postage to Canada is $0.60 for the first ounce]

29 August–1 September 2003
DRAGONCON (multimedia conference) at Atlanta Hyatt Regency & Atlanta Marriott Marquis, Atlanta GA. Registration: $60 until 15 July 2003, $75 thereafter. Info: Dragon*Con, Box 16459, Atlanta GA 30321-9998; +1.770.909.0115; www.dragoncon.org

19 - 21 September 2003
CAPCLAVE 2003 (Washington, DC area SF conference) RESCHEDULED TO 21-23 NOVEMBER 2003. See the November issue for details.

26–28 September 2003
ARCANA 33 (Minneapolis SF conference) at Twin Cities, Minnesota, hotel TBA. Guest of Honor : Gahan Wilson. Registration: $25 until 1 September 2003, $35 at door. Info: Arcana 33, Box 8036, Lake St. Station, Minneapolis MN 55408; +1.612.721.5959; eheideman@qwest.net; http://pages.prodigy.net/rekal/index.html

30 October–2 November 2003
WORLD FANTASY CONVENTION 2003 at Hyatt Regency Washington on Capitol Hill, Washington, DC. Guests of Honor: Brian Lumley, Jack Williamson. Publisher Guest of Honor: W. Paul Ganley. MC: Douglas E. Winter. Registration: $120 until 31 July 2003, $35 supporting. Info: WFC 2003, 7113 Wayne Drive, Annandale VA 22003-1734, info@worldfantasy2003.org, www.worldfantasy2003.org.

Running a convention? If your convention has a telephone number, fax number, email address, or web page URL, please let us know so that we can publish this information. We must have your information in hand SIX months before the date of your convention.

Attending a convention? When calling conventions for information, do not call collect and do not call too late in the evening. It is best to include a S.A.S.E. when requesting information; include an International Reply Coupon if the convention is in a different country. ■

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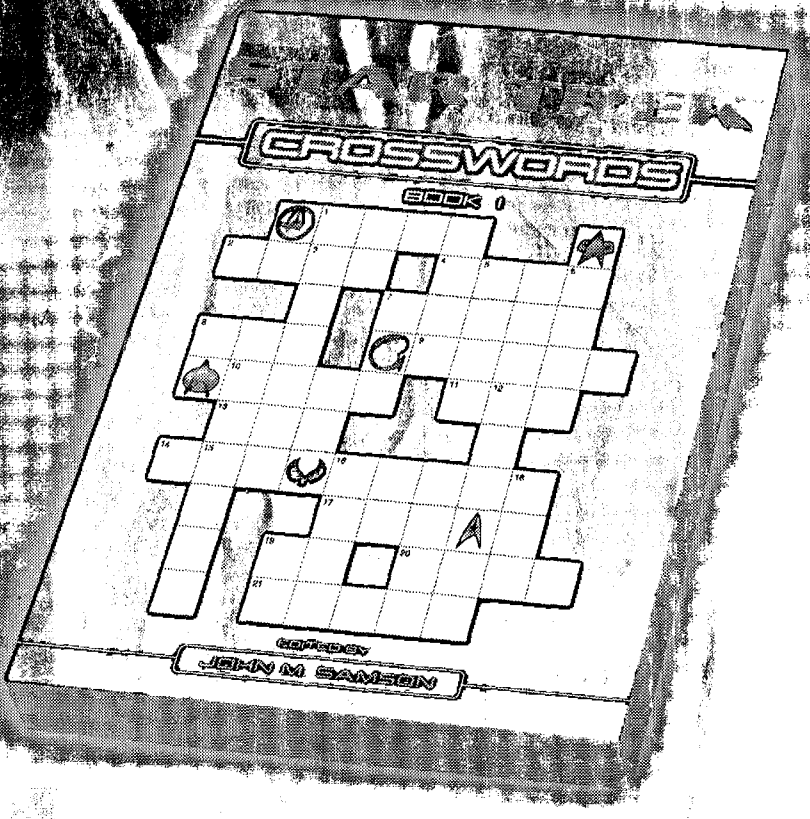

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